

MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The REVIEW for May, 1896, is based on 2,726 reports from stations occupied by regular and voluntary observers, classified as follows: 149 from Weather Bureau stations; 33 from U. S. Army post surgeons; 2,404 from voluntary observers; 32 from Canadian stations; 1 from Hawaii; 96 received through the Southern Pacific Railway Company; 11 from U. S. Life-Saving stations. International simultaneous observations are received from a few stations and used together with trustworthy newspaper extracts and special reports.

The WEATHER REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe. Unless otherwise specifically noted, the text is written by the Editor, but the statistical tables are furnished by Mr. A. J. Henry, Chief of the Division of Records and Meteorological Data. Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada, Mr. Curtis J. Lyons, Meteorologist to the Government Survey, Honolulu, and of Dr. Mariano Bárcena, Director of the Central Meteorological Observatory of Mexico.

CLIMATOLOGY OF THE MONTH.

GENERAL CHARACTERISTICS.

During May the mean temperature was remarkably high in the interior of the South Atlantic States and the Gulf States. The departures were generally from 5° to 10° above the normal. From Lake Superior southward to the Gulf and South Atlantic coasts every station reported that the mean temperature was the highest on record for this month. In contrast with this, the temperature in northern California, Nevada, Oregon, and Washington was very low, and most stations in this region report the mean temperature as the lowest on record for May. Such great contrasts over such large areas assure us that all local influences are insignificant in comparison with the broad features of the general atmospheric circulation. The average distribution of pressure and winds in the lower atmosphere has changed during the present month, as though a stronger northerly wind had brought cooler air and more rain to our northwest Pacific Coast, and as though there was thus produced an unusual eastward flow above the Rocky Mountains and an unusually rapid descent from the summits of the plateau to the valley of the Mississippi. The dynamic warming of the air had less time than usual to be dissipated by radiation, and the unusual rainfall west of the summit of the Rocky Mountains increased the föhn effect on the eastern slope, so that the temperatures in the Mississippi Valley were higher than usual. On the other hand, the tropical high pressure over the Atlantic invaded the Atlantic States to a greater extent than usual, so that southeast to southwest winds were increased, thus banking up the movement from the Pacific and producing a heavier rain in the Mississippi basin, notwithstanding the higher temperatures of that region. The monthly maps of general distribution of winds and barometric pressure over the globe show that the equatorial belt called doldrums is greatly disturbed in the course of the year by the variable influence of the sun's heat over the continents. In April the doldrums are much nearer the equator than in May, and, in fact, in the

latter month, and still more in the subsequent months, the so-called equatorial belt of low pressure moves into rather high northerly latitudes. During these months the low pressure area in the United States belongs to a branch of the equatorial trough that extends from the west coast of Ecuador northward to Alberta and beyond. The winds, the moisture, the temperature, and even the cloud forms that prevail over the interior of the United States during April and May, when this barometric condition is being developed, remind us of the conditions that prevail in the corresponding portions of the doldrums. It would, perhaps, be too much to say that the hot weather during May, 1896, was due to heat and moisture brought by southerly winds from the doldrums, and yet the distribution of the pressure was such as harmonizes with increased flow of air from the lower latitudes northward over the eastern part of the United States, and with increased flow of northerly air southward over the Pacific Coast and Rocky Mountain Plateau.

The extensive series of general storms and tornadoes, culminating on May 27 in the disaster at St. Louis, harmonize with the general statement that at this time atmospheric conditions appropriate to the equatorial regions prevailed in the interior States. In connection with this and the other tornadoes of that date, Storm Bulletin No. 4 was published on May 28. A detailed account of the St. Louis tornado, by Mr. H. C. Frankenfield, Local Forecast Official, will be found at pp. 77-81 of the MONTHLY WEATHER REVIEW for March.

ATMOSPHERIC PRESSURE.

[In inches and hundredths.]

The distribution of mean atmospheric pressure reduced to sea level, as shown by mercurial barometers, not reduced to standard gravity, and as determined from observations taken daily at 8 a. m. and 8 p. m. (seventy-fifth meridian time), is shown by isobars on Chart IV. That portion of the reduction

to standard gravity that depends on latitude is shown by the numbers printed on the right-hand border.

The mean pressures during the current month were equally high on the south Atlantic and California coasts. The highest were: Bermuda, 30.12; Charleston and Eureka, 30.11; Savannah, Jacksonville, and Jupiter, 30.09; Hatteras, Wilmington, Tampa, and Mobile, 30.08; Atlanta and Key West, 30.07.

The mean pressures were low in North and South Dakota, Manitoba, Athabasca, and the adjacent regions. The lowest were: Battleford and Prince Albert, 29.78; Qu'Appelle, Minnedosa, Winnipeg, Moorhead, Miles City, Rapid City, and El-paso, 29.80; Williston and Huron, 29.81.

As compared with the normal for May, the mean pressure was in excess in both the Atlantic and Pacific Coast regions and was deficient over the Lake Region, Mississippi Valley, and eastern Rocky Mountain Slope. The greatest excesses were: Eureka, 0.09; St. Johns, N. F., Halifax, Hatteras, and Charleston, 0.08; Jacksonville, Jupiter, Mobile, Knoxville, and Fresno, 0.07. The greatest deficits were: Winnipeg, Moorhead, and Rapid City, 0.13; Huron, 0.12; Pierre, Miles City, Concordia, and Marquette, 0.11; Duluth, 0.10.

As compared with the preceding month of April, the pressures, reduced to sea level, show a rise in Oregon, Washington, and Newfoundland, but a fall at all other stations. The greatest rises were: St. Johns, N. F., 0.13; Astoria, 0.12; Tatoosh Island and Port Angeles, 0.10. The greatest falls were: Prince Albert, Winnipeg, White River, 0.17; Ottawa, 0.16; Port Stanley and Moorhead, 0.15; Father Point, Rockcliffe, Saugeen, Sault Ste. Marie, and Minnedosa, 0.14.

AREAS OF HIGH AND LOW PRESSURE.

By Prof. H. A. HAZEN.

During May ten low areas and seven high areas have been sufficiently well defined to be traced on Charts I and II, respectively. By comparing Charts I and II side by side, the very interesting contrast is brought out that, in general, the lows mass themselves or are more abundant between the Rocky Mountains and the Mississippi River, where there are almost no highs. On the other hand, the highs are most abundant off the Atlantic Coast, where there are almost no lows.

One of the more remarkable points brought out in Chart I is the disappearance of lows near the center of the country. This is due largely to the prevalence of high pressure off the Atlantic Coast, and also to the weakness of the conditions producing the lows which permitted their rapid filling up.

The accompanying table exhibits some of the more important data of the origin, motion, and velocity of these highs and lows. Very careful attention has been paid to the motion of cirrus clouds in connection with these highs and lows. The manuscript daily cloud maps of the Weather Bureau show every cloud direction that could be observed at telegraph stations, even though the cloud was so small as to be barely visible. This gives an additional advantage to any one studying the motions of clouds. The evidence from these cloud motions shows conclusively that the upper clouds within 500 miles of high and low centers move toward the east, or if they deviate from that direction they coincide very nearly with the surface wind. This is particularly the case in the interior, but on the coast there are several exceptions showing a changing influence from the proximity of the large body of water. The following is a brief summary of each high and low.

HIGH AREAS.

I.—First noted at the mouth of the St. Lawrence a. m. of 1st. Its motion was very slow, due south, and it was last seen a. m. of 5th off the south Atlantic Coast.

II.—The origin and track of high area No. II was precisely

similar to No. I. First noted a. m. of 5th and last seen off the southeast coast of Florida p. m. of 11th.

III.—First seen p. m. of 14th in southern Georgia. Its motion was quite circuitous, by Ohio and through eastern North Carolina, south to the east coast of Florida, where it was last noted p. m. of 18th.

IV.—First seen to the north of Montana a. m. of 17th. It moved east and was last seen over Newfoundland a. m. of 22d.

V.—First seen off the middle Pacific Coast a. m. of 19th. Its motion was eastward, reaching Newfoundland a. m. of 26th.

VI.—First noted off the north Pacific Coast a. m. of 26th. It moved east-southeast, and was last seen a. m. of 30th off the North Carolina coast.

VII.—First noted to the north of Montana a. m. of 29th. It moved south-southeast and was still in existence on the last day of the month in Nebraska.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.										
I.....	1, a. m.	50	67	5, a. m.	32	78	1,650	4.0	412	17.2
II.....	5, a. m.	49	60	11, p. m.	24	79	2,990	6.5	460	19.2
III.....	14, p. m.	31	84	18, p. m.	26	80	1,990	4.0	490	30.4
IV.....	17, a. m.	53	116	22, a. m.	48	53	3,320	5.0	704	29.3
V.....	19, a. m.	41	124	26, a. m.	47	54	4,000	7.0	579	24.1
VI.....	26, a. m.	46	126	30, a. m.	34	76	2,940	4.0	735	30.6
VII.....	29, a. m.	51	116	31, p. m.	42	104	1,400	2.5	561	23.4
Sums.....							18,520	33.0	3,941	.....
Mean of 7 paths.....							2,646	4.71	563	23.5
Mean of 33.0 days.....									561	23.4
Low areas.										
I.....	1, a. m.	41	98	2, p. m.	50	86	700	1.5	468	19.5
II.....	3, a. m.	49	122	13, p. m.	53	102	3,430	10.5	326	13.6
III.....	12, a. m.	37	99	15, a. m.	49	92	1,220	3.0	406	16.9
IV.....	14, p. m.	33	114	19, a. m.	47	59	3,240	4.5	730	30.0
V.....	17, a. m.	40	104	19, a. m.	41	83	1,210	2.0	606	25.2
VI.....	17, p. m.	32	113	20, p. m.	36	97	1,840	3.0	446	18.6
VII.....	19, a. m.	51	122	23, a. m.	48	53	3,220	4.0	808	33.7
VIII.....	21, p. m.	52	119	27, a. m.	49	67	2,440	5.5	443	18.5
IX.....	26, p. m.	41	104	30, a. m.	46	76	1,780	3.5	509	21.2
X.....	27, p. m.	32	113	31, p. m.	36	98	1,870	4.0	343	14.3
Sums.....							19,960	41.5	5,075	.....
Mean of 10 paths.....									507	21.1
Mean of 41.5 days.....									481	20.0

LOW AREAS.

I.—This was noted on a. m. of 1st, in Iowa. Its track could be followed only 1.5 day, and it disappeared to the north of Lake Superior p. m. of 2d.

II.—Was first noted on the north Pacific Coast a. m. of 3d; its motion was first southeast to Nebraska and Kansas. It had a remarkable persistence in the region just east of the Rocky Mountains; it finally disappeared to the north of Montana p. m. of 13th. It was traced for 10.5 days, which gives a very long life to this low.

III.—This was first seen in south Kansas a. m. of 12th; its motion was nearly due north and it was last noted a. m. of 15th to the northwest of Lake Superior.

IV.—During the month of May there were three remarkable cases of low areas taking their origin in Arizona, viz, the present one, and Nos. VI and X. In their place of origin these lows did not display much activity, though it can not be doubted that the disturbance came from Arizona. This storm, IV, moved in a northeast direction, and disappeared over Newfoundland a. m. of 19th.

V.—Was first seen in Colorado a. m. of 17th. Its track was eastward, and it filled up in Ohio a. m. of 19th.

VI.—First noted in Arizona p. m. of 17th. Its track was due east, and very short, disappearing in Oklahoma p. m. of 20th.

VII.—First noted a. m. of 18th to the north of Washington State. Its motion was eastward, and it was last seen over Newfoundland a. m. of 23d.

VIII.—First noted at the same point as VII, p. m. of 21st. Its motion was in the same line as VII, and it was last noted at the mouth of the St. Lawrence a. m. of 27th.

IX.—First seen p. m. of 26th in extreme southwestern Nebraska. Its track was short, in an east-northeast direction, being last seen in the St. Lawrence Valley a. m. of 30th.

In connection with this storm occurred the severest tornado ever noted in this country, that at St. Louis, Mo., afternoon of 27th. A full description of this tornado, by Mr. Frankenhfield, will be found in the March WEATHER REVIEW, pp. 77-81.

X.—First noted p. m. of 27th in Arizona. Its motion was eastward, being last seen in Arkansas p. m. of 31st.

LOCAL STORMS.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

The severe local storms of the month, including under that term tornadoes, thunderstorms, high winds, with or without electrical manifestations, occurred on 22 dates, as follows: 2d, 3d, 5th, 9th, 10th, 11th, 12th, 13th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 24th, 25th, 26th, 27th, 28th, 30th, and 31st. The severity of the individual storms varied from that of an ordinary thunderstorm to that of a violent tornado. Tornadoes occurred on 10 dates, viz: 11th, 15th, 17th, 19th, 20th, 24th, 25th, 27th, and 28th (see REVIEW, March, 1896, page 82). The disturbances on the remaining dates were mainly thunderstorms and hailstorms. In some cases the wind attained a high velocity, and much damage was done to barns and outbuildings, and especially to crops.

The following is a brief statement of the general characteristics of the storm dates:

2d.—Thunderstorms occurred in the lower Lake Region and the Ohio Valley; not especially destructive.

3d.—A damaging hailstorm, having a path 2 miles in width, passed through the southern part of Vernon County, Mo.

5th.—Fruit trees and vegetables were reported as being damaged by a severe hailstorm that occurred on the line of the P. W. & B. R. R. between Port Deposit and Bush River, Md.

9th.—From the 5th to the 9th there were no severe storms. From the 9th to the end of the month storms of greater or less severity visited the greater part of the territory east of the Rocky Mountains. There were no violent storms in the Gulf States, with the exception of Texas, nor in the south Atlantic States and New England. This unusual storm period began with thunderstorms in North Dakota and Minnesota, destructive hailstorms in the northeastern portion of South Dakota, and a miniature tornado was reported near Fergus Falls, Minn.

10th.—Thunderstorm conditions prevailed over northern Texas and the Dakotas, but no severe storms occurred. A very severe windstorm was experienced in southern Maine on the night of the 10th; more than 50 barns were wrecked or injured in and about the vicinity of Belgrade, Vienna, and Mt. Vernon, all about 20 miles northwest of Augusta, and at South Jefferson, about the same distance southeast of that city; the loss was probably somewhere near \$30,000.

11th.—Tornadoes were reported from Rice County, Kans., and Worthington, Minn; loss about \$2,000.

12th.—In the West severe windstorms visited portions of Nebraska, Iowa, Kansas, Oklahoma, Texas, Illinois, and Minnesota. Tornadoes also occurred in Nebraska, Kansas, and Texas. In the East severe wind and hail storms prevailed

in Maryland and Virginia. It is not possible to estimate the damage done in the rural districts by wind and hail. Estimates of the damages to buildings, streets, sewers, electric light plants, etc., place the total for the day at \$24,000.

13th.—Heavy wind and rain storms prevailed in Maryland, Virginia, Wisconsin, Iowa, Illinois, Nebraska, Kansas, Missouri, Oklahoma, and Texas. Snow fell on the mountains of western Montana on the same date.

15th.—A series of very destructive tornadoes passed over portions of Denton and Grayson counties, Texas, on the afternoon of this date. Loss of property, \$150,000 to \$200,000. Damages to fences and outbuildings were also reported from portions of Arkansas. A tornado occurred near Moundridge, Kans. (See Special Bulletin, No. 8, of the Texas Service.)

16th.—High winds and heavy rains prevailed throughout portions of Illinois and Iowa. Damage by wind about \$15,000.

17th.—A very destructive tornado visited the counties of Clay, Riley, Marshall, Nemaha, and Brown, Kans., and Richardson, Nebr., on the afternoon of this date. Graves and Marshall counties, Ky., were also the scene of tornadic violence on the same date. The winds throughout Wisconsin and Lower Michigan reached the proportions of a gale. Strong winds were also reported from Buffalo and Niagara, N. Y.

18th.—Severe wind and hail storms prevailed in Maryland and Virginia; houses were unroofed in Baltimore and other points, and many trees were prostrated.

19th.—Severe thunderstorms occurred at a number of points in Missouri. The damage by wind and water in that State, and also in Minnesota and Illinois, was very great. At Eldon and Sedalia, Mo., the losses are reported to have been at least \$50,000.

20th.—Tornadoes occurred in Lyon and Cowley counties, Kans., also near Topeka in the same State, and in Kay Co., Cherokee Strip, Okla. Damages light.

21st.—A heavy thunderstorm damaged buildings, fences, and standing timber in the southern part of Adair County, Ky. Heavy rains in Missouri and southern Kansas caused a general flooding of all the streams and much damage to bottom lands, fences, and bridges.

24th.—Hailstorms occurred in portions of the Dakotas and Minnesota, and destructive tornadoes and floods in Iowa.

25th.—The Iowa storm of the 24th continued throughout northern Illinois, being most severe in Ogle and Winnebago counties, and near Chicago. An independent series of very destructive tornadoes occurred in southeastern Michigan on the evening of the same date.

26th.—Severe wind and rain storms visited portions of Tennessee, Kentucky, Ohio, West Virginia, and Virginia.

27th.—The most destructive tornado in the history of the country passed over St. Louis, Mo., at 6.10 p. m. of this date (see p. 77 March REVIEW). Portions of Indiana and Ohio were also visited by severe and destructive windstorms on the night of the 27th.

28th.—A series of violent thunderstorms passed over Virginia, Maryland, Delaware, Pennsylvania, and New Jersey on the afternoon of this date. In southeastern Pennsylvania tornadoes occurred in two separate localities. The property losses were very great.

30th.—A severe windstorm visited the southern and western sections of Chicago; trees were blown down and a number of outbuildings were damaged.

31st.—High winds accompanied by a heavy downpour of rain were experienced in eastern Kansas and western Missouri on the morning of the 31st.

TEMPERATURE OF THE AIR.

[In degrees Fahrenheit.]

The mean temperature is given for each station in Table

II, for voluntary observers. Both the mean temperatures and the departures from the normal are given in Table I for the regular stations of the Weather Bureau.

The monthly mean temperatures published in Table I, for the regular stations of the Weather Bureau, are the simple means of all the daily maxima and minima; for voluntary stations a variety of methods of computation is necessarily allowed, as shown by the notes appended to Table II.

The regular diurnal period in temperature is shown by the hourly means given in Table V for 29 stations selected out of 82 that maintain continuous thermograph records.

The distribution of the observed monthly mean temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart IV; the lines are drawn over the Rocky Mountain Plateau Region, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the country occupied by our observers; such isotherms are controlled largely by the local topography, and should be drawn and studied in connection with a contour map.

The highest mean temperatures were: Key West, 79.4; Corpus Christi, 77.9; New Orleans, 77.8; Jacksonville, 77.7; Savannah and Pensacola, 77.6; Charleston and Yuma, 76.8. The lowest mean temperatures were: Eastport, 48.2; Tatoosh Island, 48.4. Among the Canadian stations the highest were: Bermuda, 68.6; Port Stanley, 59.1. The lowest were: St. Johns, N. F., 39.8; Grindstone, 41.0; Banff, 41.5; Sydney, 43.6; Calgary, 44.6.

As compared with the normal for May the mean temperature for the current month was in excess in the Lake Region, the valleys of the Mississippi and its tributaries, the Atlantic and Gulf States. The greatest excesses were: Port Stanley, 10.4; White River, 9.8; Greenbay, 9.5; Chicago, 9.2; Minneapolis and Cleveland, 9.1. The temperature was generally deficient over the Rocky Mountain and Pacific Coast Region and Newfoundland. The greatest deficits were: Walla Walla, 8.4; Salt Lake City, 7.9; Baker City, 6.7; Calgary, Spokane, and Helena, 6.4.

Considered by districts the mean temperatures for the current month show departures from the normal as given in Table I. The greatest positive departures were: Lower Lake, 7.1; Upper Lake, 8.2; Upper Mississippi, 7.4; Southern Slope (Abilene), 7.0.

The years of highest and lowest mean temperatures for May are shown in Table I of the REVIEW for May, 1894. The mean temperature for the current month was the highest on record at: Abilene, 78.8; Galveston, 78.4; Corpus Christi, 77.9; New Orleans, 77.8; Savannah and Columbia, S. C., 77.6; Augusta, 77.4; Shreveport, Tampa, Vicksburg, 77.2; Meridian and Montgomery, 77.0; Charleston, 76.8; Mobile, Palestine, Pensacola, 76.6; Memphis, 76.4; Little Rock, 75.6; Charlotte, 75.2; Atlanta, 74.9; Wilmington, 74.4; Fort Smith, Chattanooga, and Raleigh, 74.0; Nashville, 73.5; Oklahoma, 73.3; Knoxville, 73.2; St. Louis, 73.0; Cairo, 72.7; Louisville, 72.6; Wichita, 71.8; Cincinnati and Columbia, Mo., 71.2; Lexington, 70.9; Hatteras and Indianapolis, 70.8; Keokuk and Parkersburg, 70.2; Springfield, Ill., 70.0; Topeka, 69.8; Columbus, Ohio, 69.7; Kansas City, 69.6; Springfield, Mo., 69.5; Pittsburg, 69.2; Dodge City, 68.4; Dubuque, 68.0; Concordia, 67.5; Harrisburg, 66.0; Cleveland, 65.8; Chicago, 65.5; Detroit, 65.3; Sioux City, 64.4; Minneapolis, 64.0; Greenbay, 62.9; Port Huron, 62.8; Pueblo, 62.2; Milwaukee, 62.1; Grand Haven, 61.8; Alpena, 56.6; Sault Ste. Marie, 53.6; Duluth, 52.3. It was the lowest on record at: Baker City, 46.4; Helena and Idaho Falls, 46.6; Winnemucca, 48.6; Port Angeles, 49.0; Fort Canby, 49.7; Neahbay, 49.8; Spokane, 50.4; Carson City, 50.6; Astoria, 51.2; Salt Lake City, 51.4; Eureka, 51.5; Portland, Oreg., 52.2; Walla Walla, 54.4; Sacramento, 60.0; Red Bluff, 61.2; Fresno, 63.9.

The maximum and minimum temperatures of the current month are given in Table I. The highest were: 112, Yuma (27th); 110, Phoenix (28th); 105, Abilene (30th); 103, Los Angeles (25th); 102, El Paso (29th), Fresno (26th); 101, Dodge City (24th). The lowest maxima were: 61, Tatoosh Island (29th); 62, Eureka (frequently); 65, Fort Canby (29th); 68, Astoria (28th). The highest minima were: 71, Key West (frequently); 70, Port Eads (frequently); 65, New Orleans (frequently), Galveston (3d), Corpus Christi (10th); 64, Pensacola (2d); 63, Mobile (7th). The lowest minima were: 19, Lander (15th); 24, Idaho Falls, (18th); 26, Cheyenne (14th), Baker City (18th), Winnemucca and Carson City (10th); 29, Northfield (1st), Helena (17th); 30, Havre (3d), Salt Lake City (15th); 31, Rapid City (15th), Santa Fe (14th); 32, Miles City and Denver (15th).

The years of highest maximum and lowest minimum temperatures are given in the last four columns of Table I of the current REVIEW. During the present month the maximum temperatures were the highest on record at: Yuma, 112; Abilene, 105; Los Angeles, 103; Dodge City, 101; San Diego and Amarillo, 98; Wichita, Charleston, and Baltimore, 96; Meridian, 95; Louisville and Oklahoma, 94; New Haven, Little Rock, Palestine, 93; Lexington, New Orleans, Narragansett Pier, 92; Eastport and Point Reyes Light, 85. The minimum temperatures were the lowest on record at: Fort Canby, 38; Salt Lake City, 30.

The greatest daily range of temperature and the extreme monthly ranges are given for each of the regular Weather Bureau stations in Table I, which also gives data from which may be computed the extreme monthly ranges for each station. The largest values of the greatest daily ranges were: Bismarck and Pueblo, 45; Duluth, Lander, and Dodge City, 44; Northfield, Harrisburg, El Paso, and Yuma, 43; Amarillo, and Narragansett Pier, 42; San Luis Obispo, Idaho Falls, and East Clallam, 41. The smallest values were: Key West, 12; Galveston, 14; Corpus Christi and Tatoosh Island, 15; Jupiter and New Orleans, 19; Fort Canby and Eureka, 20. Among the extreme monthly ranges the largest values were: Phoenix, 65; Lander and Yuma, 63; Los Angeles, 62; San Luis Obispo and Fresno, 61; Dodge City, 60. The smallest values were: Key West, 14; Galveston and Corpus Christi, 21; Jupiter and Eureka, 24; Pensacola and Tatoosh Island, 26; Fort Canby and New Orleans, 27.

The accumulated monthly departures from normal temperatures from January 1 to the end of the current month are given in the second column of the following table, and the average departures are given in the third column for comparison with the departures of current conditions of vegetation from the normal condition.

Districts.	Accumulated departures.		Districts.	Accumulated departures.	
	Total.	Average.		Total.	Average.
Middle Atlantic.....	+ 3.1	+ 0.6	New England.....	- 1.1	- 0.2
South Atlantic.....	+ 8.0	+ 1.6	Florida Peninsula.....	- 9.3	- 1.9
West Gulf.....	+ 6.5	+ 1.3	East Gulf.....	- 0.8	- 0.2
Ohio Valley and Tenn.....	+ 9.6	+ 1.9	Middle Plateau.....	- 0.9	- 0.2
Lower Lake.....	+ 9.1	+ 1.8	North Pacific.....	- 2.9	- 0.6
Upper Lake.....	+ 18.0	+ 3.6	Middle Pacific.....	- 0.9	- 0.2
North Dakota.....	+ 8.7	+ 1.7			
Upper Mississippi.....	+ 20.1	+ 4.0			
Missouri Valley.....	+ 20.6	+ 4.1			
Northern Slope.....	+ 8.2	+ 1.6			
Middle Slope.....	+ 20.9	+ 4.2			
Abilene (southern Slope).....	+ 17.0	+ 3.4			
Southern Plateau.....	+ 4.4	+ 0.9			
Northern Plateau.....	+ 10.8	+ 2.2			
Southern Pacific.....	+ 3.1	+ 0.6			

The limit of freezing weather is shown on Chart VI by the isotherm of minimum 32°, and the approximate limit of frost by the isotherm of minimum 40°. These minimum

temperatures are such as occur within the thermometer shelters of the Weather Bureau stations.

MOISTURE.

The quantity of moisture in the atmosphere at any time may be expressed by the weight of the vapor coexisting with the air contained in a cubic foot of space, or by the tension or pressure of the vapor, or by the temperature of the dew-point. The mean dew-points for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, are given in Table I.

The rate of evaporation from a special surface of water on muslin at any moment determines the temperature of the wet-bulb thermometer, but a properly constructed evaporometer may be made to give the quantity of water evaporated from a similar surface during any interval of time. Such an evaporometer, therefore, would sum up or integrate the effects of those influences that determine the temperature as given by the wet bulb; from this quantity the average humidity of the air during any given interval of time may be deduced.

Measurements of evaporation within the thermometer shelters are difficult to make so as to be comparable at temperatures above and below freezing, and may be replaced by computations based on the wet-bulb temperatures. The absolute amount of evaporation from natural surfaces not protected from wind, rain, sunshine, and radiation, are being made at a few experimental stations and will be discussed in special contributions.

Sensible temperatures.—The sensation of temperature experienced by the human body and ordinarily attributed to the condition of the atmosphere depends not merely on the temperature of the air, but also on its dryness, on the velocity of the wind, and on the suddenness of atmospheric changes, all combined with the physiological condition of the observer. A complete expression for the relation between atmospheric conditions and nervous sensations has not yet been obtained.

PRECIPITATION.

[In inches and hundredths.]

The distribution of precipitation for the current month, as determined by reports from about 2,500 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III. The total precipitation for the current month was heaviest (14 to 18 inches) in a small portion of western Missouri; it exceeded 6 inches in western Kentucky and the greater part of Illinois, Iowa, and Missouri, as also in eastern Kansas and Nebraska, southern Minnesota, Wisconsin, and Indiana. No rain fell, except an occasional "trace" in New Mexico, Arizona, and the southern portions of California and Nevada. The larger values at regular stations were: St. Louis, 9.1; Omaha, 9.5; Topeka, 9.3; Springfield, Mo., 11.5.

The diurnal variation, as shown by tables of hourly means of the total precipitation, deduced from self-registering gauges kept at the regular stations of the Weather Bureau, is not now tabulated.

The current departures from the normal precipitation are given in Table I, which shows that precipitation was in excess over a region extending from northern North Carolina and southern Virginia westward to Arkansas and Missouri and thence northward to Manitoba, thence west and south-west to the Pacific Coast. The large excesses were: Cairo, 7.0; Cape Henry, 6.7; Springfield, Mo., 5.4; St. Louis and Sault Ste. Marie, 4.5; Astoria, 3.8; Williston, 3.7; Topeka and Duluth, 3.6; Eureka, 3.2; Hannibal, 3.1; Sioux City, 3.0. The large deficits were: Little Rock, 4.4; Charleston and Vicksburg, 3.5; Hatteras, 3.1; Galveston, Meridian, and Jupiter, 3.0.

The average departure for each district is also given in Table

I. By dividing these by the respective normals the following corresponding percentages are obtained (precipitation is in excess when the percentages of the normals exceed 100):

Above the normal: Middle Atlantic, 103; North Dakota, 170; upper Mississippi, 141; Missouri Valley, 145; middle Plateau, 232; northern Plateau, 154; north Pacific, 143; middle Pacific, 144.

Below the normal: New England, 80; south Atlantic, 73; Florida Peninsula, 47; East Gulf, 53; West Gulf, 67; Ohio Valley and Tennessee, 89; lower Lake, 60; upper Lake, 95; northern Slope, 96; middle Slope, 83; southern Slope (Ablene), 19; southern Plateau, 15; south Pacific, 38.

The years of greatest and least precipitation for May are given in the REVIEW for May, 1890. The precipitation for the current month was the greatest on record at: Springfield, Mo., 11.46; Cairo, 10.82; Cape Henry, 10.61; St. Louis, 9.12; Sault Ste. Marie, 6.70; Williston, 5.79; Havre, 4.27; Idaho Falls, 2.78; Winnemucca, 2.77. It was the least on record at: Eastport, 1.00; Pierre, 0.30; Rapid City, 0.60.

The total accumulated monthly departures from normal precipitation from January 1 to the end of the current month are given in the second column of the following table; the third column gives the ratio of the current accumulated precipitation to its normal value.

Districts.	Accumulated departures.	Accumulated precipitation.	Districts.	Accumulated departures.	Accumulated precipitation.
	Inches.	Per ct.		Inches.	Per ct.
North Dakota.....	+ 3.90	162	New England.....	- 3.50	82
Upper Mississippi.....	+ 0.40	103	Middle Atlantic.....	- 1.70	94
Missouri Valley.....	+ 1.50	112	South Atlantic.....	- 4.80	76
Northern Slope.....	+ 0.40	107	Florida Peninsula.....	- 2.70	80
Middle Plateau.....	+ 2.30	134	East Gulf.....	- 6.00	76
North Pacific.....	+ 5.70	119	West Gulf.....	- 3.90	79
Middle Pacific.....	+ 3.10	117	Ohio Valley and Tenn....	- 6.00	72
			Lower Lakes.....	- 0.40	97
			Upper Lakes.....	- 0.90	93
			Middle Slope.....	- 2.10	77
			Ablene (southern Slope).....	- 5.80	42
			Southern Plateau.....	- 0.80	65
			Northern Plateau.....	- 0.30	97
			South Pacific.....	- 1.80	77

Details as to excessive precipitation are given in Tables XII and XIII.

The total monthly snowfall at each station is given in Table II. Its geographical distribution is shown on Chart VI. The southern limit of freezing temperatures and possible snow is shown on this chart by the isotherm of minimum 32°. The isotherm of minimum 40°, namely, the air temperature within the thermometer shelter, is also given on this chart, and shows approximately the southern limit of frost on exposed surfaces.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 1, 22, 26. Arizona, 29. Arkansas, 2, 12, 13, 15, 28. California, 4 to 9, 11, 18, 28, 29. Colorado, 21. Connecticut, 31. District of Columbia, 28. Florida, 4, 6, 15, 21. Georgia, 2, 22, 26, 29. Idaho, 1 to 9, 11 to 17, 19 to 23, 25, 26, 28, 29. Illinois, 1, 11 to 21, 25 to 28, 30. Indiana, 1, 4, 11, 13, 18 to 21, 25 to 28. Indian Territory, 16. Iowa, 1, 11 to 14, 16, 17, 18, 23, 24, 26, 27. Kansas, 3, 4, 8 to 23, 25, 26, 27, 29, 30, 31. Kentucky, 1, 2, 11, 19, 26. Louisiana, 13, 14, 20. Maine, 5, 10, 30. Maryland, 12, 18, 19, 26, 28. Massachusetts, 5, 11, 17. Michigan, 4, 6, 11, 12, 14, 25, 27, 28, 30. Minnesota, 7 to 12, 16, 23, 25, 26, 28. Mississippi, 1, 2, 3, 13, 14, 28. Missouri, 1, 2, 11, 12, 13, 15 to 21, 23, 24, 26, 27, 28, 30, 31. Montana, 6, 8, 9, 10, 12, 14, 15, 24, 25. Nebraska, 3, 7, 8, 11, 12, 15, 16, 17, 19, 20, 23, 24, 26, 27. Nevada, 29. New Hampshire, 5, 10, 22, 29, 30. New Jersey, 5, 15, 17, 28,

31. New Mexico, 12. New York, 3, 4, 11, 17, 27, 28, 30. North Carolina, 2 to 5, 14, 17 to 20, 22, 23, 24, 26, 29. North Dakota, 2, 4 to 11, 15, 16, 18, 24, 26, 27, 28, 29. Ohio, 2, 3, 5, 11 to 14, 18, 19, 21, 25, 26, 28, 30. Oklahoma, 13, 16, 21, 27, 28. Oregon, 1 to 5, 8, 9, 11, 12, 14, 16, 17, 20, 21, 22. Pennsylvania, 5, 14, 15, 18, 26, 30. South Carolina, 1, 3, 17, 18, 21, 26, 28. South Dakota, 2, 7, 11, 16, 23, 24. Tennessee, 2, 17, 19, 22, 26, 27, 28, 31. Texas, 1 to 4, 8, 9, 10, 12, 13, 21, 27, 30. Utah, 5, 10, 11, 15, 19, 29. Vermont, 30. Virginia, 12, 13, 18, 19, 22, 26. Washington, 1 to 5, 8, 10 to 16. West Virginia, 12, 13, 14, 18, 24, 25, 26, 29. Wisconsin, 1, 12, 13, 14, 24, 25, 26, 29, 30.

SLEET.

The following are the dates on which sleet fell in the respective States:

California, 7. Montana, 5, 14, 17, 18, 19. Nevada, 9, 11, 15. Oregon, 1, 2. Washington, 2, 13, 16.

WIND.

The prevailing winds for May, 1896, viz, those that were recorded most frequently, are shown in Table I for the regular Weather Bureau stations.

The resultant winds, as deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart IV, where the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a uniform wind of average velocity. These figures indicate the relative extent to which winds from different directions counterbalanced each other.

HIGH WINDS.

Maximum wind velocities of 50 miles or more per hour were reported during this month at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles				Miles	
Amarillo, Tex.	8	60	s.	Moorhead, Minn.	12	63	se.
Buffalo, N. Y.	28	52	sw.	New York, N. Y.	18	52	w.
Do.	29	53	w.	Do.	19	52	sw.
Cairo, Ill.	26	60	nw.	North Platte, Nebr.	6	55	se.
Cheyenne, Wyo.	11	52	w.	Port Huron, Mich.	17	54	sw.
Do.	25	50	w.	Do.	28	54	sw.
Chicago, Ill.	14	60	s.	St. Louis, Mo.	27	80	nw.
Do.	17	58	sw.	San Antonio, Tex.	2	60	nw.
Do.	25	62	s.	Springfield, Ill.	26	60	nw.
Cleveland, Ohio	28	50	w.	Tatoosh Island, Wash.	8	52	ne.
Davenport, Iowa	16	60	nw.	Washington, D. C.	19	50	nw.
El Paso, Tex.	12	52	nw.	Do.	28	54	sw.
Do.	29	55	sw.	Williston, N. Dak.	2	60	nw.
Huron, S. Dak.	7	51	se.	Do.	10	60	se.
Do.	9	52	s.	Winnemucca, Nev.	22	55	s.
Marquette, Mich.	25	52	se.	Do.	29	50	sw.

SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 17 regular stations of the Weather Bureau by its photographic, and at 21 by its thermal effects. At one station records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric sheets show seventy-fifth meridian time; for convenience the results are all given in Table XI for each hour of local mean time.

Photographic and thermometric registers give the duration of that intensity of sunshine which suffices to make a record, and, therefore, they generally fail to record for a short time after sunrise and before sunset, because, even in a cloudless sky, the solar rays are then too feeble to affect the self-registers. If, therefore, such records are to be used for determining the amount of cloudiness, they must be supplemented by special observations of the sky near the sun at these times. The duration of clear sky thus specially determined constitutes the so-called twilight correction (more properly a low-sun correction), and when this has been applied, as has been done in preparing Table XI, there results a complete record of the clearness of the sky from sunrise to sunset in the neighborhood of the sun. The twilight correction is not needed when the self-registers are used for ascertaining the duration of a special intensity of sunshine, but is necessary when the duration of cloudiness is alone desired, as is usually the case.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table XI.

COMPARISON OF DURATIONS AND AREAS.

The details are shown in the following table, in which the stations are arranged according to the greatest possible duration of sunshine, and not according to the observed duration as heretofore.

Difference between instrumental and personal observations of sunshine.

Stations.	Apparatus.	Total possible duration for the whole month.	Personal estimated area of clear sky.	Instrumental record of sunshine.			
				Photographic.	Difference.	Thermometric.	Difference.
		Hrs.	\$	\$	\$	\$	\$
Bismarck, N. Dak.	P.	467.4	46	49	+3	49	0
Helena, Mont.	P.	467.4	44	49	+5	49	0
Portland, Oreg.*	P.	464.1	43	34	-9	34	-9
Eastport, Me.	P.	464.1	43	60	+17	60	+17
Northfield, Vt.	P.	457.9	42	52	+10	52	+10
Portland, Me.†	P.	457.9	43	56	+13	56	+13
Buffalo, N. Y.†	T.	454.9	46	56	+10	56	+10
Rochester, N. Y.	T.	454.7	69	87	+18	87	+18
Boston, Mass.	T.	451.9	46	58	+12	58	+12
Chicago, Ill.	T.	451.9	66	78	+12	78	+12
Cleveland, Ohio	P.	451.9	52	61	+9	61	+9
Des Moines, Iowa.	T.	451.9	34	62	+28	62	+28
Detroit, Mich.	T.	451.9	63	79	+16	79	+16
Eureka, Cal.	P.	449.1	47	53	+6	53	+6
New York, N. Y.	P.	449.1	46	49	+3	49	+3
Salt Lake City, Utah.	P.	449.1	26	53	+27	53	+27
Columbus, Ohio	P.	446.7	43	57	+14	57	+14
Denver, Colo.	P.	446.7	50	58	+8	58	+8
Philadelphia, Pa.	T.	446.7	36	64	+28	64	+28
Baltimore, Md.	T.	443.8	34	82	+48	82	+48
Cincinnati, Ohio	T.	443.8	56	80	+36	80	+36
Kansas City, Mo.	P.	443.8	40	52	+12	52	+12
St. Louis, Mo.	P.	443.8	55	74	+19	74	+19
Washington, D. C.	P.	443.8	40	45	+5	45	+5
Dodge City, Kans.	P.	441.7	58	63	+5	63	+5
Louisville, Ky.	T.	441.7	32	74	+42	74	+42
San Francisco, Cal.	T.	441.7	62	68	+6	68	+6
Santa Fe, N. Mex.	P.	436.7	64	81	+17	81	+17
Little Rock, Ark.	T.	434.2	61	79	+18	79	+18
Atlanta, Ga.	T.	432.6	53	86	+33	86	+33
Wilmington, N. C.	T.	432.6	55	71	+16	71	+16
Phoenix, Ariz.	P.	430.7	80	89	+9	89	+9
San Diego, Cal.	P.	430.7	65	74	+9	74	+9
Savannah, Ga.	P.	428.4	69	73	+4	73	+4
Vicksburg, Miss.	T.	428.4	72	77	+5	77	+5
New Orleans, La.	T.	423.7	64	67	+3	67	+3
Galveston, Tex.	P.	421.8	67	74	+7	74	+7

* Records by both methods. † Records for only 22 days, for which the total possible duration of sunshine was 322.9 hours. ‡ Records for 25 days; total possible, 364.5 hours.

The sunshine registers give the durations of effective sunshine whence the duration relative to possible sunshine is derived;

the observer's personal estimates give the percentage of *area* of clear sky. These numbers have no necessary relation to each other, since stationary banks of clouds may obscure the sun without covering the sky, but when all clouds have a steady motion past the sun and are uniformly scattered over the sky, the percentages of duration and of area agree closely. For the sake of comparison, these percentages have been brought together, side by side, in the following table, from which it appears that, in general, the instrumental records of percentages of durations of sunshine are almost always larger than the observers' personal estimates of percentages of area of clear sky; the average excess for May, 1896, is 8 per cent for photographic and 14 per cent for thermometric records.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table X, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—The dates on which reports of thunderstorms for the whole country were most numerous were: 11th, 237; 12th, 237; 13th, 223; 18th, 233; 19th, 256; 26th, 258; 28th, 254.

Thunderstorm reports were most numerous in: Illinois, 326; Iowa, 219; Missouri, 470; North Carolina, 245; Ohio, 345.

Thunderstorms were most frequent in: Kansas, 28 days; Nebraska and North Carolina, 27; Missouri and South Carolina, 26; Arkansas, Minnesota, and Ohio, 25.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 22d to the 30th, inclusive. On the remaining twenty-two days of this month 203 reports were received, or an average of about 9 per day. The dates on which the number of reports especially exceeded this average were: 2d, 78; 3d, 19; 17th, 57; 18th, 17.

Auroras were reported by a large percentage of observers in: New Hampshire, 43; New York, 24; Minnesota, 30; Wisconsin, 78.

Auroras were reported most frequently in: Wisconsin, 10 days; Minnesota, 9; Iowa, 8; North Dakota and New Hampshire, 7; Michigan, 6.

CANADIAN REPORTS.

Thunderstorms were reported as follows: 1st, Saugeen;

2d, Toronto, Port Stanley; 3d, Rockcliffe, Port Stanley; 4th, Port Stanley, Saugeen, Swift Current; 5th, Yarmouth; 6th, Minnedosa, Qu'Appelle, Prince Albert; 8th, Winnipeg; 9th, Winnipeg, Minnedosa; 10th, Grand Manan, St. Andrews, Rockcliffe; 11th, Grand Manan, Port Stanley, Winnipeg, Qu'Appelle, Swift Current; 12th, Charlottetown, Port Stanley, Minnedosa; 14th, Port Stanley; 15th, Toronto, Saugeen, Port Stanley; 16th, Swift Current; 17th, Rockcliffe, Toronto, Port Stanley; 18th, Grindstone, Halifax, Yarmouth, Toronto; 19th, Port Stanley; 21st, Swift Current; 22d, Halifax, St. Andrews, Quebec, Swift Current; 23d, Minnedosa, Swift Current; 24th, Minnedosa; 25th, Toronto, Port Stanley, Saugeen, Parry Sound; 26th, Quebec, Port Stanley; 27th, Yarmouth, Saugeen; 28th, Toronto, Port Stanley; 29th, Halifax, Minnedosa, Swift Current; 31st, Yarmouth.

Auroras were reported as follows: 1st, Quebec; 2d, Halifax, Yarmouth, Charlottetown, Quebec, Montreal, Winnipeg; 3d, Father Point, Quebec, Port Arthur, Minnedosa, Battleford; 4th, Father Point, Winnipeg; 6th, Quebec, Winnipeg; 7th, Port Arthur, Winnipeg; 11th, Father Point, Quebec; 14th, Quebec; 15th, Father Point; 16th, Port Arthur, Montreal; 17th, St. Johns, Halifax, Yarmouth, Quebec, Montreal, Toronto; 18th, Quebec, Montreal, Winnipeg, Battleford; 19th, Quebec, Port Arthur; 20th, Grindstone, Prince Albert; 21st, Prince Albert; 22d, Prince Albert; 23d, Father Point.

INLAND NAVIGATION.

The *extreme and average stages of water* in the rivers during the current month are given in Table VIII, from which it appears that the only river which attained the danger line was the Mississippi, at La Crosse, Wis., which reached 10.7 on the 24th and 25th. But in consequence of the heavy rains in the lower Missouri watershed numerous small streams overflowed, especially in Kansas, Iowa, Illinois, and Missouri, and the Mississippi rose steadily up to the close of the month at all stations between St. Louis and Vicksburg.

METEOROLOGY AND MAGNETISM.

By Prof. FRANK H. BIGELOW.

The values of H given in the table of Chart V are to be added to 0.18250, those of D to 180', these numbers being the means for Toronto and Washington. A strong disturbance of the magnetic field occurred from May 2 to May 4, but did not effect the other elements. The circulation of the atmosphere was very stagnant from May 1 to May 13. A severe storm then occurred in the Lake Region, May 15 to May 17. A brisk eastward movement in the northern circuit set in about May 18, and continued to the end of the month.

CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective services.

Snowfall and rainfall are expressed in inches.

Alabama.—The mean temperature was 75.8°, or 2.5° above normal; the highest was 100°, at Tuscaloosa on the 25th, Pineapple on the 26th, and Union on the 31st; the lowest was 49°, at Valley Head on the 30th. The average precipitation was 3.44, or 0.51 below the normal; the greatest monthly amount, 6.32, occurred at Bermuda, and the least, 1.18, at Union.

Arizona.—The mean temperature was 72.4°, or 3.5° above normal; the highest was 117°, at Parker on the 26th and at Fort Mohave on the 27th, and the lowest, 22°, at Flagstaff on the 21st. The average precipitation was "trace," or 0.32 below normal; "trace" was the greatest amount recorded anywhere, and was reported from 16 stations, while no precipitation occurred at numerous other stations.

Arkansas.—The mean temperature was 74.4°, or 5.4° above normal,

and is the highest during the past fourteen years; the highest was 98°, at Helena on the 8th and at Camden on the 31st, and the lowest, 46°, at Keesees Ferry on the 2d. The average precipitation was 3.54, or 1.34 less than normal; the greatest monthly amount was 8.35, at Moss-ville, and the least, 0.76, at Luna Landing.

California.—The mean temperature was 61.2°, or 2.9° below normal; the highest was 124°, at Salton, in the desert regions, on the 27th, and lowest, 12°, at Bodie, in the high mountain regions, on the 10th. The average precipitation was 1.36, or 0.50 above normal; the greatest monthly amount, 10.03, occurred at Bear Valley, while none fell at numerous points.

Colorado.—The month was warmer than usual in all sections, except the extreme northwestern part of the State, where it was slightly cooler. The highest temperature was 100°, at Minneapolis on the 29th and at Delta on the 30th; the lowest, 10° below zero, occurred at Climax on the 14th. The average precipitation was 1.15, or 1.08 below normal; the greatest monthly amount was 5.60, at Longmont; no precipitation occurred at Saguache and only a "trace" at La Jara.

Florida.—The mean temperature was 74.7°, or 1.4° below normal; the

highest was 100°, at Clermont on the 19th, at McClenny on the 25th, at Grasmere on the 27th, and at Earnestville on the 31st; the lowest, 48°, occurred at McClenny on the 9th. The average precipitation was 2.73, or 1.62 below normal; the greatest monthly amount, 9.02, occurred at Myers, and the least, 0.54, at Key West. The various interests in all walks of life keenly felt the absence of the necessary moisture.

Georgia.—The mean temperature was 76.0°, or more than 4.0° above normal; the highest was 101°, at Brag on the 11th, and the lowest, 44°, at Eastman on the 9th. The average precipitation was 2.54, or about 1.25 below normal; the greatest monthly amount, 6.16, occurred at Fleming, and the least, 0.85, at Alapaha.

Idaho.—The mean temperature was 47.0°; the highest was 93°, at Lewiston on the 29th, and the lowest, 11°, at Swan Valley on the 11th and at Birch Creek on the 18th. The average precipitation was 3.03; the greatest monthly amount, 6.26, occurred at Idaho City, and the least, 0.43, at Challis.

Illinois.—The mean temperature was 69.5°, or 7.7° above normal; the highest was 98°, at Paris on the 10th, and the lowest, 41°, at Chemung on the 31st, and at Zion on the 19th. The average precipitation was 5.78, or 1.42 above normal; the greatest monthly amount, 13.21, occurred at Albion, and the least, 2.35, at Fort Sheridan.

Indiana.—The mean temperature was 69.3°, or 7.2° above normal; the highest was 96°, at Vincennes on the 10th and 11th, and the lowest, 44°, at Delphi on the 4th and at Hammond on the 20th. This was the warmest May on record. The average precipitation was 4.50, or 0.27 above normal; the greatest monthly amount, 8.55, occurred at Princeton, and the least, 1.97, at Columbus.

Iowa.—The mean temperature was 65.5°, or 5.8° above normal; the highest was 100°, at Cedar Rapids on the 6th, and the lowest, 34°, at Indianola on the 1st, at Glenwood on the 14th, and at Rock Rapids on the 19th. The average precipitation was 6.69, or 2.54 above normal; the greatest monthly amount, 11.79, occurred at Mount Ayr, and the least, 3.40, at Mount Vernon.

Kansas.—The mean temperature was 69.3°, or 5.1° above normal; the highest was 107°, at Macksville on the 24th, and the lowest, 30°, at Jaqua on the 12th. The average precipitation was 4.75. There was an excess of 2.09 in the eastern division and 0.40 in the middle division, while there was a deficiency of 0.77 in the western division. The greatest monthly amount, 12.67, occurred at Fort Scott, and the least, "trace," at Sharon Springs. On the 17th a tornado, originating in the northern part of Clay County, and passing northeast across Washington, Marshall, Nebraska, and Brown counties, into Nebraska, destroyed much property and some life.

Kentucky.—The mean temperature was 72.2°, or 7.1° above normal; the highest was 106°, at Ashland on the 10th, and the lowest, 42°, at Lexington on the 30th. The average precipitation was 5.34, or 1.03 above normal; the greatest monthly amount, 11.78, occurred at Fords Ferry, and the least, 1.65, at Richmond.

Louisiana.—The mean temperature was 77.7°, or 4.2° above normal; the highest temperature was 101°, at Liberty Hill on the 31st, and the lowest, 53°, at Minden on the 1st. This was the warmest May on record. The average precipitation was 2.20, or 1.43 below normal; the greatest monthly amount, 4.89, occurred at West End, and the least, 0.14, at Venice.

Maryland.—The mean temperature was 65.8°, or 3.5° above normal; the highest was 96°, at Baltimore and Johns Hopkins Hospital on the 10th, at Westernport, Md., and Wilmington, Del., on the 11th, and at Van Bibber, Md., on the 18th; the lowest, 31°, occurred at Princess Anne on the 8th. The average precipitation was 3.20, or 0.73 above normal; the greatest monthly amount, 6.44, occurred at Seaford, Del., and the least, 0.87, at Green Spring Furnace, Md.

Michigan.—The mean temperature was 62.2°, or 8.0° above normal, and the highest mean temperature for May on record; the highest was 97°, at Three Rivers on the 8th, and the lowest, 25°, at Lathrop on the 20th. The average precipitation was 3.22, or 0.54 below normal; the greatest monthly amount, 8.10, occurred at Benton Harbor, and the least, 1.11, at Saginaw.

Minnesota.—The mean temperature was 60.9°, or 4.5° above normal; the highest was 93°, at Wabasha on the 8th, and the lowest, 23°, at Leech Lake Dam on the 4th. The average precipitation was 5.02, or 1.28 above normal; the greatest monthly amount, 10.60, occurred at Lambert, and the least, 2.57, at St. Cloud.

Mississippi.—The mean temperature was 77.4°, or 5.1° above normal; the highest was 110°, at Williamsburg on the 14th, and the lowest, 46°, at the same place on the 3d. The average precipitation was 2.71, or 1.44 below normal; the greatest monthly amount, 8.16, occurred at Leakesville, and the least, 0.41, at Brookhaven.

Missouri.—The mean temperature was 70.1°, or 6.4° above normal, and at many stations it was the warmest day on record; the highest was 96°, at Neosho on the 16th, and the lowest 32° (?) at the same station on the 2d. The average precipitation was 9.09, or 4.28 in excess of normal; the greatest monthly amount, 18.23, occurred at Osceola, and the least, 4.08, at Birch Tree. In many counties the heavy rains, in some instances amounting to cloudbursts, resulted in floods which did immense damage to property and crops and caused the loss of a number of lives. The Osage River and its tributaries were nearly as high as during the memorable flood of last December; and many other

streams, in different sections of the State, were as high, or higher, than ever before known. Thousands of acres of growing crops on bottom lands were ruined by the overflowing of the streams, and much corn on flat land was also drowned out. In all sections more or less damage was done on rolling land by the washing away of soil, and, in some instances, considerable corn was washed up.

Montana.—The mean temperature was 49.0°, or 4.0° below normal; the highest was 90°, at Billings on the 23d, and the lowest, 16°, at Butte. The average precipitation was 3.14, or 1.38 above normal; the greatest monthly amount, 7.32, occurred at Wibaux, and the least, 1.43, at Butte. Heavy rains were reported from all sections of the State, and at the close of the month the ground was thoroughly soaked, and many rivers were high, and many were overflowing their banks.

Nebraska.—The mean temperature was 63.6°, or 4.5° above normal; the highest was 102°, at Benkleman on the 29th, and the lowest, 25°, at Whitman on the 17th. The average precipitation was 4.03, or 0.42 above normal; the greatest monthly amount, 13.77, occurred at Rulo, and the least, 0.56, at Kirkwood.

New England.—The mean temperature was 58.5°, or 3.0° above normal; the highest was 96°, at Lawrence, Mass., on the 10th, and the lowest, 22°, at West Milan, on the 1st. The average precipitation was 2.58, or 1.04 less than normal; the greatest monthly amount, 5.33, occurred at Norwalk, Conn., and the least, 0.90, at Strafford, Vt.

New Jersey.—The mean temperature was 65.3°, or 5.1° above normal; the highest was 98°, at Paterson on the 9th and 10th, and the lowest, 29°, at Charlotteburg, River Vale, and Allaire on the 1st. The average precipitation was 3.21, or 0.63 below normal; the greatest monthly amount, 4.54, occurred at Elizabeth, and the least, 1.62, at Camden and Friesburg.

New Mexico.—The mean temperature was considerably above the normal; the highest was 110°, at Rincon on the 28th, and the lowest, 13°, at Chama on the 13th. The average precipitation was below normal; the greatest monthly amount, 0.60, occurred at La Belle, while none fell at Eddy, Los Lunas, and Raton.

North Carolina.—The mean temperature was 72.2°, or 5.2° above normal; the highest was 99°, at Rockingham and Tarboro on the 11th, and the lowest, 39°, at Linville on the 30th. The average precipitation was 4.28, or 0.03 above normal; the greatest monthly amount, 11.22, occurred at Falkland, and the least, 0.52, at Southport.

North Dakota.—The mean temperature was 56.9°, or 23° above normal; the highest was 103°, at Larimore on the 7th, and the lowest, 22°, at Dickinson on the 19th. The average precipitation was 4.89, or 2.65 above normal; the greatest monthly amount, 8.61, occurred at Mayville, and the least, 1.98, at Bismarck and Fort Yates.

Oklahoma.—The mean temperature was 75.4°; the highest was 108°, at Arapahoe on the 30th, and the lowest, 3°, at Burnett on the 2d. The average precipitation was 3.79; the greatest monthly amount, 10.51, occurred at Vinita, and the least, 0.71, at Winnview.

Pennsylvania.—The mean temperature was 65.4°, or 5.9° above normal; the highest temperature recorded was 98°, at Aqueduct on the 17th, and the lowest, 31°, at Blooming Grove on the 1st. The average precipitation was 2.85, or 2.48 below the average; the greatest monthly amount, 6.30, occurred at Bethlehem, and the least, 1.19, at Cannonsburg.

South Carolina.—The mean temperature was 76.7°, or 7.7° above normal; the highest was 104°, at Gillisonville on the 11th, and the lowest, 42°, at Allendale and Georgetown on the 9th. This was the warmest May ever recorded in the State. The average precipitation was 2.74, or 1.62 below normal; the greatest monthly amount, 6.07, occurred at Pinopolis, and the least, 0.52, at Charleston.

South Dakota.—The mean temperature was 6.09°, or about 5.5° above normal; the highest was 110°, at Vermilion on the 7th, and the lowest, 22°, at Cross on the 15th. The average precipitation was 2.42, or 0.99 below normal; the greatest monthly amount, 5.80, occurred at Gary, and the least, 0.03, at Nowlin.

Tennessee.—The mean temperature was 73.0°, or more than 6° above normal; the highest was 96°, at Arlington on the 9th and at Brownsville on the 27th, and the lowest, 45°, at Bristol on the 28th. The past was the warmest May on record. The average precipitation was 3.81, or 0.25 below normal; the greatest monthly amount, 6.95, was recorded at Byrdstown, and the least, 0.80, at Brownsville.

Texas.—The mean temperature was 3.8° above normal; the highest was 110°, at Midland on the 24th, and at Rhineland on the 31st, and the lowest, 33°, at Hartley on the 21st. The average precipitation was 1.80 below normal; the greatest monthly amount, 4.13, occurred at Palestine, and the least, "trace," at Blanco, El Paso, Point Isabel, Hartley, and Rock Springs.

Utah.—The mean temperature was 51.0°; the highest was 104°, at St. George on the 28th, and the lowest, 12°, at Soldier Summit on the 14th. The average precipitation was 1.52; the greatest monthly amount, 4.22, was recorded at Park City, and the least, "trace," at Cisco.

Virginia.—The mean temperature was 68.7°, or about 4° in excess of normal; the highest was 98°, at Bonair on the 12th, 14th, and 25th, and at Buckingham and Smithville on the 11th; the lowest was 23°, at Guinea on the 9th. The average precipitation was 4.56, or 0.12 above normal; the greatest monthly amount, 10.61, occurred at Cape Henry, and the least, 1.43, at Stephens City.

Washington.—The mean temperature was 51.0°, or 3.4° below normal;

the highest was 93°, at Fort Simcoe on the 28th, and the lowest, 20°, at Cascade Tunnel on the 3d. This was the coolest May on record. The average precipitation was 3.21, or 0.62 above normal; the greatest monthly amount 7.74, occurred at Ashford, and the least, 0.53, at Kennewick.

West Virginia.—The mean temperature was 68.1°, or about 6.0° above normal; the highest was 95°, at Point Pleasant on the 10th and at Spencer on the 11th, and the lowest, 33°, at Beckly (Raleigh) on the 4th. This was the warmest May on record. The average precipitation

was 3.01, or about 0.75 below normal; the greatest monthly amount, 5.92, occurred at Fairmont, and the least, 0.65, at Beckly.

Wisconsin.—The mean temperature was 62.9°, or about 6.0° above normal; the highest was 93°, at Butternut and Prairie du Chien on the 6th, and the lowest, 29°, at Florence on the 20th. Heavy frosts occurred at several northern stations on the 31st. The average precipitation was 5.00, being slightly below normal in the southeastern counties and much above normal in the Grand River Valley; the greatest monthly amount, 9.35, occurred at West Bend, and the least, 2.44, at Delevan.

SPECIAL CONTRIBUTIONS.

RECENT PUBLICATIONS.

By Dr. J. H. McCARTY, Librarian Weather Bureau.

- Austria.—Hungary.** Die Luftwiderstands-Gesetze; der Fall durch die Luft und der Vogelflug. Mathematisch-Mechanische Klärung auf experimenteller Grundlage entwickelt von Friedrich Ritter von Loessl, ober Ingenieur. 8vo. 304 pp. Wien. 1896.
- France.**—Annales de l'Observatoire Royal de Belgique. Observations Meteorologique D'Uccle 1894. 4to. 40 pp. Bruxelles. 1896.
- British Empire.—Australia.** The Abercromby Essays, on the Australian Weather. Three Essays by H. C. Russel and Henry A. Hunt. 101 pp. and 4 plates. Sydney. 1896.
- British Empire.—England.** Reduction of Greenwich Meteorological Observations. Part III. Temperature of the Air as determined from the observations and records of the fifty years, 1841 to 1890, made at the Royal Observatory, Greenwich, now directed and discussed under the direction of W. H. M. Christie, M. A., F. R. S., Astronomer Royal. Fol. 119 pp. 1 plate 12 by 16. London. 1895.
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- Germany.**—Der Vogelflug, als Grundlage der Fliegekunst von Otto Lilienthal. 8vo. 187 pp. 1 frontispiece, 8 diagrams, 80 woodcuts. Berlin. 1889.
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- Russia.**—(In the Polish language.) Meteorological Bulletin, 1st part, for the year 1893. 4to. 76 pp. Warsaw. 1895.
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THE DESTRUCTIVE FORCES OF HURRICANES AND THE CONDITIONS OF SAFETY AND DANGER.

Extracts from communication by GEN. E. P. ALEXANDER, of Georgetown, S. C. (dated May 29, 1896).

It is the purport of this article to set forth some of the practical conclusions and results of a study of the destructive forces of the tropical hurricanes which sometimes assail our Atlantic and Gulf coasts in the months of August, September, and October. The study was suggested by personal experiences and observations on several occasions, but more particularly in the storm of August 27, 1893, which destroyed over 2,000 lives and perhaps \$1,000,000 worth of property. Newspapers and magazines for months afterward teemed with accounts of the havoc wrought, and of the noble charities for the relief of the desolated communities to which the occasion gave rise. But the popular ideas of the dangerous forces of the hurricane as given by the published accounts are exceedingly vague and indefinite, exaggerated in some respects, and underestimated in others. One magazine, for instance, stated that many persons were killed by "sheer pressure and fury of the wind, not a bruise being found on their bodies." Such a statement is merely absurd. But to the ignorant it suggests mysterious and universal destruction, against which no precautions are of any avail.

In every hurricane there are many individuals who escape and many structures that withstand it. An intelligent study of the conditions surrounding these individuals and buildings will give us a fair measure of the force of the wind and waves and will suggest the most effective means of protection. Briefly, it may be said that the dangerous elements are so limited and precautionary measures are so simple and easy,

that it is only through negligence that lives are lost on land and dwellings destroyed.

The hurricane of the Atlantic and the typhoon of the Pacific must be sharply distinguished from the tornado that occurs on land, not only in America, but also in Europe, Africa, and India. Atlantic hurricanes are generated in the region where the northeast trade winds die out as they approach the belt of the equatorial calms. They reach the Atlantic or Gulf States principally between July and October. The most violent winds whirl around a central region of low barometric pressure which is in the midst of a much larger area of cloud and rain. The whirl is always in the same direction, viz, such as to carry an object from the north side of the central region around by the west to the south, and thence around by the east to the north side again. This circulation is technically spoken of as a negative rotation, or one that is contrary to the direction of motion of the hands of a watch. As the winds on the south side of such a hurricane blow eastward, this circulation is also spoken of as being against the sun, since the sun appears to move from the east by the south toward the west. The maximum velocity of the hurricane wind has been known to exceed the rate of 120 miles per hour, but this is only in puffs of a few seconds' duration, as the total movement of the wind for a whole hour rarely exceeds 60 miles. Now, wind pressure is usually estimated at 2 pounds per square foot of surface when blowing perpendicularly to that surface with a velocity of 20 miles per hour; 8 pounds for 40 miles, and 18 pounds for 60 miles, the pressure increasing as the square of velocity.

If we assume the highest velocities and calculate the pressures by this rule, we would expect few ordinary houses to resist them. But, in the wake of a storm, a study of the structures which fail and of those which resist is generally calculated to surprise an observer far more by the apparently weak ones which have resisted the winds than by the apparently substantial ones which have failed. And when those which have failed are examined, it will be found, almost invariably, that failures are due to unstable foundations or to lightly attached roofs. In fact, it may be taken as a measure of the force of hurricane winds that the frame of any ordinarily good house will resist them. But the foundations must be firm and the roofs fairly well framed and attached. In new houses, by the use of wooden ceiling instead of plastering, and a few angle irons and bolts, one can easily have a structure, like a double box, which could be almost rolled over without injury. Old houses, badly constructed and with poor foundations, may be easily preserved by a few stout braces or inclined props on sides opposite the wind. In short, the wind of a cyclone by itself seldom works serious injury. It is only where it has the water as an ally and accumulator of its forces that its ravages are great. When a hurricane passes inland, it soon becomes little more than a bit of very bad weather. Its great instrument of destruction is the so-called tidal wave or storm tide, or, more properly, storm wave, which is raised by it and which submerges the low lands of the coast. Below the limit to which these waves rise is the zone of danger in a hurricane; above it is the zone of easily attained safety.

How far this danger line may extend above ordinary high water depends so largely upon local configuration of coasts that it is only to be determined for any locality by observation. Unfortunately, reliable measurements and data upon this point are rare and difficult to obtain. Popular accounts are always exaggerated, being largely based upon the action of surface billows, which send water and drift far above the general level of the storm wave. A vessel, for instance, drawing 8 feet, may be carried by successive billows across a marsh submerged only 4 feet beneath the general level. I have read accounts of combined storm waves and high tides rising 10 or

12 feet above ordinary high water mark, but when the action of billows is eliminated and careful measurements are made, the highest record of a storm tide above ordinary high water which I have been able to find anywhere is 8.2 feet. This limit was reached at Fort Pulaski, Ga., in the great gale of August 27, 1893, which broke all records in the height of its waters, in the destruction of life and property, and in the measured velocity of its winds, which at Charleston for a few moments exceeded 120 miles per hour. As this gale is one of great interest, the reader is referred to the records published in the MONTHLY WEATHER REVIEW for October, 1893, page 297. The center of the hurricane passed directly over Savannah, and it will be seen that there the barometer fell lowest and the storm tide rose highest, the wind falling to a dead calm for twenty minutes as the center passed, after which it rose from the opposite quarter. The center passed about 80 miles west of Charleston. The accompanying diagram (Fig. 1) shows the phenomena of this date.

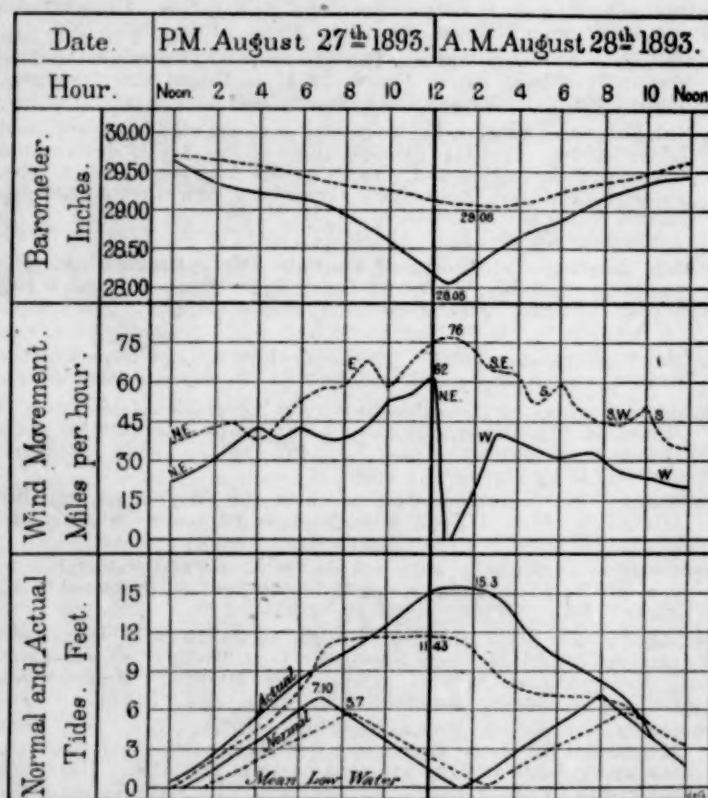


FIG. 1.—Barometer reading and movement of wind and tides at Charleston, S. C., and Savannah, Ga. Dotted lines show Charleston records and solid lines show Savannah records.

The following table shows the rise of the tide caused by this hurricane, and for comparison, also the highest storm tides ever recorded at several Atlantic, Gulf, and Lake ports, as shown by records of the U. S. Coast Survey and Engineer offices.

Highest storm tides at various points.

Locality.	Date.	Height of tide.	Moon's age.
Boston, Mass.	April 16, 1851	5.3	15
Sandyhook, N. J.	Sept. 10, 1880	3.9	14
Fort Monroe, Va.	Mar. 10, 1846	5.1	12
South Island, S. C.	Oct. 13, 1893	6.8	2
Fort Sumter, S. C.	Aug. 27, 1893	6.4	14
Fort Pulaski, Ga.	Aug. 27, 1893	8.2	14
Mobile, Ala.	Oct. 2, 1893	7.0	20
Buffalo, N. Y.	Jan. 9, 1889	8.0	6
Duluth, Minn.	Sept. 28, 1895	4.0	9

The plane of reference is ordinary high water, and the age of the moon is given in each case to indicate whether the storm tide coincided with the normal high tides, which occur at all the Atlantic ports about each full or new moon. There is no tide at Lake ports, and but little in the Gulf.

From the above we see that the serious ravages are committed by the water rather than by the wind, and that they are confined to a narrow zone seldom, if ever, reaching more than 8 or 9 feet above the plane of ordinary high water. Above that zone ordinary well built houses will easily resist the winds if the house and the roof are securely framed together and the foundations are stable. If there are weak points, even cheap and ordinary props or braces, which can be improvised rapidly, are very effective in breaking up vibrations and resisting the pushes and shakes of the wind. Within the zone of danger from water, the dash of the waves and the tendency of the water to lift and float all wooden structures must be provided for. The limits of this article do not permit a full discussion of the magnitudes of these dangers and the various means by which they may be met, but it may be said briefly that pile foundations, or the equivalent, posts framed into buried timbers, are at once cheap and efficient.

A very instructive illustration is shown in some photographs of Krantz's cottages at Grand Isle, Barataria Bay, La., before and after the hurricane of October 2, 1893, in which over a thousand lives were lost on the coast of Louisiana. [This hurricane did not affect the South Carolina coast as seriously as the following one of October, 13, 1893.] These photographs show that the cottages were not materially damaged by the wind, scarcely even a blind was torn off, but they were simply floated off their low brick foundations and drifted up together. Had they been raised a few feet upon piles, or even on substantial brick pillars and bolted to them, slight injury would have been done and no lives lost.

In Georgetown County, S. C., after the great gale of 1822, in which 200 lives were lost, the rice planters on two exposed islands built brick storm towers, large enough to shelter all their slaves, which towers are still intact. Others built storm proof cabins and storm proof rooms adjoining their summer houses on the beaches, some of which, still standing in 1893, preserved the lives of their occupants while their neighbors were drowned.



FIG. 2.—Storm-proof cabin of 1822.

Within the danger zone stables should always have an elevated floor or platform, with an inclined plane by which stock can reach it. A few barrels of fresh water stored away at the approach of a gale, and covered against salt spray, will often prove a great boon to both man and beast. At isolated camps and fields where individuals may be suddenly surprised, a safe refuge may be quickly made in a tree by

cutting off the top and limbs to diminish the danger of its being blown over, and fixing a seat and lashings and means of ascent. Where there is no secure refuge above the reach of water a boat or raft should always be prepared beforehand, and retreat should be made while the winds are blowing on shore.

The above suggestions are enough to indicate not only how easily intelligent foresight can protect life and property, but also how extremely valuable are timely warnings to those living in the danger zone when a hurricane is coming. No matter what precautions have been taken beforehand, it is worth while to overhaul everything. When harvesting is going on and men, animals, vehicles, and boats are scattered far and wide, cutting, curing, and handling the crops, every possible hour of warning is of great value.



FIG. 3.—Storm-proof tower of 1822.

The sky and clouds give their own warnings of the approach of a hurricane, but the trouble about these is that the sky gives so many false alarms. It is easier for the Weather Bureau to give ample warning of an approaching hurricane. At its birth in the doldrums the storm has a moderate drift to the westward. It gradually turns slowly northward. After it leaves the tropics it gradually moves in a northeast direction. But from our picket stations in the West Indies our Weather Bureau can be promptly notified of its birth and movements long before it can make an assault upon our shores, should it head in our direction. If the warnings of the Weather Bureau, therefore, are promptly transmitted to the communities which are exposed along the seacoast, these can interpret the daily aspects of their own skies with some confidence, and need never lose work by taking false alarm, or be taken unawares by real danger.

Until recently the warnings given by the Weather Bureau were confined to the display of danger signals at the ports and towns along the coast. A great advance has been made by the employment of special boats and launches, which, upon occasion, are sent to carry messages to isolated places. But a still further advance is practicable, and should be carried out by combined official and private enterprise. The present system might be supplemented by branch lines of sound signals, such as the firing of guns,¹ or the explosion of some cheap form of bomb, by which warnings may be quickly conveyed to the laborers in the most distant fields, the fishermen on the farthest banks, and the occupants of the most isolated cabins. These are the people whose lives and property are oftenest lost for the lack of warning.

¹ On account of the numerous accidents incident to the careless use of cannon, bombs, and explosives, it has therefore been deemed wisest to rely upon the telegraph, telephone, flags, and other visual signals.—[C. A.]

To give some idea of the frequency of tropical hurricanes a table is attached giving dates of all that have occurred on the coast of South Carolina for two centuries.

Hurricanes on the coast of South Carolina.

Year.	Month.	Day.	Lives lost.	Moon's age.
1700	Sept	16	.....	1
1713	do	16	.....	25
1726	do	14	.....	8
1732	do	15	20	5
1787	do	.....	23	.....
1797	do	5	.....	12
1804	do	7	.....	1
1811	do	10	.....	22
1813	Aug	27	15	0
1815	Sept	28	.....	25
1822	do	27	300	10
1830	Aug	16	.....	27
1837	Sept	1	.....	0
1841	do	16	.....	29
1844	Oct	.....	.....	.....
1846	Aug	16	.....	23
1850	do	24	.....	16
1851	do	24	.....	27
1852	do	27	.....	11
1854	Sept	7	.....	14
1871	Aug	19	.....	3
1874	Sept	28	2	16
1878	do	11	.....	13
1881	Aug	27	.....	3
1889	Oct	11	.....	29
1890	Aug	25	21	14
1893	do	27	2,000	14
1898	Oct	13	25	2
1894	Sept	27	.....	27

The above table gives the dates of all tropical hurricanes that have visited the coast of South Carolina during the last two centuries of which record can be found. Where loss of life on land is mentioned, the estimated number is given. The moon's age at each date is also shown, to indicate whether the hurricane occurred nearest the time of spring or neap tides. Of 29 in all, 16 fell nearest to the spring tides, and 11 the neap.

REPORT ON THE TORNADOES OF MAY 25 IN THE STATE OF MICHIGAN.

By NORMAN B. CONGER, Inspector, Weather Bureau (dated Detroit, June 22, 1896).

The data for this report is gathered from all reliable, available sources, but the most reliable data is contained in the report of the committee on cyclone damages appointed by Governor John T. Rich to ascertain the total damages and the amount of relief necessary in the district covered by the tornado. The report of this committee covers the counties of Oakland and Lapeer only, and it is in this district that the majority of the damage occurred, and where the tornado was most severe. That report covers the path of the storm so fully that it will not be necessary to repeat it. Reports were also received from the postmasters at Dryden, Utica, Amadore, Fostoria, Otisville, Oakwood, Ortonville, Otterlake, Metamora, Thomas, and one by Mr. Alexander G. Burns, of this office, who made personal inspection of the track of the storm that passed over Walkerville, Canada, just across the river from Detroit.

I made a personal visit the day after the storm to Thomas (Oakland County) to observe the action of the tornado and to follow its path for a short distance and observe its characteristics. The greatest damages were observed at Ortonville, Oakwood, and Thomas, in the northeast corner of the county.

I have made a careful study of the path of the storm at Thomas, Oakland County, and inclose a sketch, Chart No. VIII, drawn by Mr. E. F. Hulbert, showing the manner in which the storm distributed the debris.

The path of the storm was distinctly marked at Thomas. The south side of the storm showed all the trees, houses, and fences thrown to the northeast, while in the center of the path, which was probably an eighth of a mile in width at this point, the debris was laid to the east. The fence rails were laid due east and west, and all were laid out as carefully as

though placed there by the hand of man. No two rails were laid one on another. On the north side, where the distinct path was of the same width as the center, the houses and debris were all turned to the south or southwest, with some few pieces lying to the west. From conversation with those who had visited the whole district, I learned that the same characteristics were observed throughout the length of the path. It was noticed in the center of the path that the grass was pounded down into the earth as though it had been washed into the earth by a heavy flow of water. The small trees on the south side of the path were stripped of their bark, even to the twigs, as though done by the careful hand of an experienced artisan. On one side of the road which runs north, at Thomas, the house of Mr. Kidder was carried bodily for about 300 feet, and then smashed into the earth, the contents of the house scattered beyond finding, while across the road, some 600 feet to the north, the frame house of Mr. Copland was taken free from the stone foundation, and the debris were found from 2 to 10 miles farther east-northeast. All that was left of his house was a square piano, which was standing on its side some 200 feet directly north of the foundations of the house, one end being pounded full of grass. One peculiarity of the freaks of this storm was the unroofing of the post office at Thomas, leaving only the lower story standing, and in the window was still displayed the weather forecast card of the day: "Severe local thunderstorms this afternoon and to-night; showers followed by fair, Tuesday." The forecast had been terribly fulfilled in this section.

Tornadoes occurred, or windstorms were reported, at about 6 p. m., local time, and at about 20 localities in the following counties, as represented on the map: Montcalm, Kalkaska, Midland, Bay, Tuscola, Genesee, Lapeer, Oakland, Macomb, St. Clair, Sanilac, and Wayne, the most damage occurring in the counties of Oakland, Lapeer, and Genesee, in the order named. That in Kalkaska County simply cut a path through the woods, and did not touch any houses.

The report of the damages from the storm at Mr. Clemens', Macomb County, has not been received, but the storm was quite severe there, and 2 lives were lost.

The reports from all sources indicate that there were 45 lives lost, about 100 persons injured more or less severely, and about \$400,000 in damages to houses, barns, etc. The report of the committee gives also the amount of damage to crops, orchards, and fences in Lapeer and Oakland counties only.

KITE EXPERIMENTS AT THE WEATHER BUREAU.

By C. F. MARVIN, Professor of Meteorology, U. S. Weather Bureau.
[Continued from April REVIEW.]

In the April REVIEW the manner of using steel wire for the kite line was described and the results of experiments given, showing the strength and the best arrangement of the wire, splices, string, and other members composing the kite line. The means employed for determining accurately the length of wire unwound from the reel in any case were also given. We will next consider the action of the forces on kites and the form and construction of those with which experiments were made at the Weather Bureau.

General remarks on single plane and cellular kites.—Before the writer began work upon the kite problem many efforts had been made to reach great elevations with kites of the Malay type, the construction of which has already been described. It was often found that these kites would not continue to behave properly hour after hour. When several kites were flying in tandem they would fly very nicely for a time, but a strong gust of wind or the continued action of moderate winds would cause some derangement in one or more of the kites. This would mar the success of the experiment, if it did not bring about some worse result. The real cause of such difficulties was not fully understood at that

time. Subsequent experience with other forms of kites has shown how some of the difficulties might have been avoided. The general conclusion, however, is that single-plane kites are believed to be less reliable than kites of the cellular type. The latter are necessarily heavier in construction, but the several sustaining surfaces seem to be disposed in a manner to act with greater efficiency. The cellular or multi-plane kites are also far steadier than single-plane kites, and we believe that they are better adapted than the latter to maintain their equilibrium under great variations of wind force. On the other hand, the single-plane kites, on account of their lightness per unit area, are probably superior to the cellular kites in light winds. Single-plane kites generally prove to be steadier when the covering is fitted loosely, so that it bellies backward with the wind pressure. This looseness, however, is objectionable, for the reason that it is difficult to make the two halves of the kite perfectly symmetrical. The covering, which is generally of cloth, is likely to stretch unevenly with exposure to winds. The kite thereby becomes unsymmetrical, even while in the air, and begins to behave badly. Probably no greater source of difficulty with single-plane kites exists than the uneven stretching and flexure of the material of the kite. The symmetry of the kite is thus impaired. The ill effects of uneven stretching are greatly aggravated in kites in which the cloth is necessarily cut on the bias, as is noticeably the case in kites of the Malay type. Moreover, a nicer condition of symmetry is necessary in the less stable single-plane kites than in the more stable, steady, cellular forms. In these latter, too, the stretched surfaces of covering material are, as a rule, rectangular in form. Stretching, therefore, is apt to take place in a symmetrical manner and is then attended with little or no ill effect.

From such considerations as these, and the promising results of a few preliminary experiments with a Hargrave kite, the writer was led to adopt the cellular type of kite for further development. He still hopes to be able to determine numerically the efficiency of single-plane kites, as has already been done for the cellular kites, and thereby be better able to judge intelligently of the relative merits of the two forms. As yet, however, the necessary observational data have not been obtained.

ANALYSIS OF FORCES ACTING ON KITES.

Explanation of terms.—The terms *pull*, *lift*, and *drift* are frequently employed in connection with kites, and, as confusion has arisen in the minds of some concerning their use, a full explanation of their meaning appears to be required.

Pull.—The force which tends to tear asunder the kite string is regarded by the writer as the *pull* of the kite, or the *tension* of the string. I do not see that any better or more descriptive words are needed. In the case of a long, deeply sagging line it is plain that the absolute direction in which the pull operates is very different at different points along the line, but always tangent thereto. Moreover, the intensity of the force is also different. We may, nevertheless, with perfect consistency and without confusion, call this force pull or tension at any and every point. To be explicit in speaking of the pull, we need to specify also the point at which the tension is exerted, or the direction in which it acts. We may imagine the kite to be nearly in the zenith and pull the wire upward at a high angle. There is nothing in this circumstance to cause us to change the name of the force under consideration, as has been done by some. The force is just as much as ever the *pull of the kite*, or the *tension of the wire*, no matter at what angle it may act. Such expressions, therefore, as the *pull at the kite* or the *tension of the wire at the reel* seem to me to carry a definite meaning with them.

Lift.—The inherent idea conveyed by the word *lift*, when used to designate some force, is that of an effort which is

opposed to the force of gravity. In other words, a lifting force is an effort which is directed vertically upward. The use of this word in connection with kites will, perhaps, be made clearer by the following illustration: Suppose the string from a flying kite be tied to a heavy stone. The pull of the kite being exerted in an upwardly inclined direction, the tendency will be to both *lift* the stone off the ground and also to drag it across the surface. That portion of the total pull which tends to raise the stone directly off the ground is the *lift* of the kite.

Drift.—The foregoing illustration serves also to bring out the meaning of the word *drift*, as applied to the kite. That portion of the total pull which tends to drag the stone horizontally across the surface of the ground is called the *drift* of the kite. It is that effect of the total pressure of the wind on the kite which tends to cause the kite to drift horizontally along with the wind. The kite must, however, be held in restraint against the force of the wind, otherwise the drift, as a force, does not exist; if the kite is not restrained, motion sets up and the drift regarded as a force is greatly changed in amount.

In the language of mechanics these words are perfectly defined by saying that *drift* is the horizontal and *lift* the vertical component of the *pull*.

The *lift* of a kite is important for the reason that it measures the amount of weight that the kite can sustain. Weights to be sustained are usually attached to the string. It is a matter of importance at which point along the kite line a given weight to be sustained is attached, for a little study will show that the lift and drift have different values at different points of the line. The more the line sags between any two points the greater will be the differences between the corresponding forces at those points. Fig. 27 represents a long deeply sagging kite line, and will serve to illustrate further the relations between the lift, drift, and pull. At the point *A*, for example, the *pull* is represented by the line *AB*, tangent to the wire. By drawing horizontal and vertical lines through both *A* and *B*, the line *AL* represents the *lift*, the line *AD* the *drift*. Similarly, at *a* the lift and drift are represented by the lines *al* and *ad*. In this case the line *ab* is made equal to *AB*, that is, the tensions at the two points are regarded as equal. This could not be true in an actual case, as the pull at *a* will always be less than at *A*, depending upon the weight of the portion of wire *aA*. Nevertheless, even though the pull is regarded as uniform in the diagram, the lift and drift are seen to be noticeably different. At *O*, where we have supposed the line to be horizontal the lift has vanished entirely and the drift is numerically equal to the pull. At the reel the lift is no longer a true lifting force; it even acts downward. In other words, the lift is negative. If at any point the kite line were exactly vertical, then the drift would entirely vanish and the lift would be numerically equal to the pull at that point. Such cases will rarely occur as regular working conditions in practical kite flying for scientific purposes. They are noticed here merely for the sake of illustration. They represent some of the conditions that may temporarily obtain where a long line is out and the wind falls off so much in force that the wire sags down quite to the ground.

The effect of hanging a weight upon the kite string is shown at *W*. The line *WP* represents the magnitude and direction of the pull of the string, *WG* represents the force of gravity. *WP'* is the resultant of these two forces, and the direction the string takes below the point *W* must be identical with *WP'*. Moreover, the length of the line *WP'* represents the tension in the string below *W*.

Resolution and combination of forces.—To proceed intelligently with the construction of kites a general knowledge of the action of the forces thereon is necessary. For our pres-

ent purpose we will consider kites of the tailless variety only. The position a kite takes in the air will depend upon the resultant effect of five forces acting upon it and the string. So far as the kite itself is concerned we may, however, leave the string out of account and the two forces affecting it, and deal only with the forces acting at the kite. In this case there are three forces: (1) The pressure of the wind on the surfaces of the kite. (2) The action of gravity on the mass of kite. (3) The pull of the string at the kite.

When the kite flies steadily in a fixed position these three forces are in equilibrium. Whenever they are not in equilibrium some one of them preponderates in a certain sense, and the kite shifts its position to the right or left, or rises or falls in such a manner as tends to reestablish equilibrium. That is, a properly made kite will behave in this way. With a kite of improper form and badly arranged parts, no matter how much it darts and shifts about, it is impossible for the kite to move into and stay in a position where the forces just balance each other. The conditions may be such that changes of position do not tend to bring the kite into static equilibrium. The kite, in such cases, may spin around and around in a circle whose diameter is sometimes quite small, but often very great; or, the kite may swing back and forth far to the right and left without finding a position in which it can fly steadily. Such kites, generally, will not continue to fly very long. The oscillations, gyrations, and darting motions which for a time contribute to maintain flight may either gradually bring the kite down lower and lower, or some change in the forces of a marked or critical nature may suddenly end all flight with a precipitate dash to the earth.

Of the three forces in action, gravity alone is perfectly constant in amount and direction. The tension on the string is a force that exists only as the result of the action of the other forces. The wind pressure, then, is the only force which varies independently, and the great problem is to arrange the surfaces and bridle of the kite so that it can promptly, constantly, and easily accommodate itself to the innumerable and often very great and very sudden changes which we find to occur in the force and direction of the wind.

Wind pressure on plane surface.—The pressure of the wind upon the kite surfaces is a very complex force. We are able to understand its action best by resolving it into component parts and separately studying the effects of each.

In Fig. 28, $A B C D$ represents, in cross section, a flat rectangular plate exposed to the wind in an inclined position. The windward and leeward edges of the plate are supposed to be perpendicular to the paper and therefore at right angles to the wind, which is supposed to move in lines parallel to the paper. The thickness of the plate has been purposely exaggerated in order to give prominence to the effect of the wind on the edges of the plate. In kites the edge surfaces are of relatively small extent, but their influence is large enough to be important and it is necessary, therefore, to notice the effect this has on the total pressure. Experiments have shown that the wind will glide over a smooth surface, such as we have supposed our plane to be, with great freedom. In other words, the skin friction is exceedingly slight. The action of the wind upon the surface is, therefore, in the nature of a normal pressure exerted at every point. For if we suppose the skin friction to be zero, then the pressure at each point due to the wind will be exerted exactly at right angles to the surface at that point. In the case of slightly roughened, fuzzy, surfaces, such as the cloth used in kites, it may not be strictly admissible to wholly neglect skin friction. In this case the air must be regarded as catching upon the roughnesses of the surface and exerting a slight push or force which urges the plane along in the direction in which the streams of air are flowing over its surface. Fig. 29 shows on a larger scale these forces of pressure and friction as they may be conceived to

act on a single point, P , of the surface. $P P$ represents the relatively large pressure acting directly at right angles to the surface; $F P$ represents the feeble force of friction acting parallel to the plane. From mechanics we learn that the combined effect of these two forces is the same as that of a single force represented by the line, $Q P$, which is the diagonal of a parallelogram formed on the lines $P P$ and $F P$. The total pressure on the whole surface of $A B$ is simply the sum of all the elementary pressures like $Q P$. If we may neglect skin friction the pressure of the wind acts at right angles to the surface. If the skin friction is great enough to require consideration, then we must regard the wind pressure as acting at a less angle than 90° to the surface. It may be added here that the wind pressure experienced by a plane surface is due to the diminution of the pressure of the air on the back, or lee side, of the plate as well as to the direct impact of the wind on the forward side. For our present purposes we need not push the analysis so far as to separate these effects but will combine them into a resultant pressure on the front face of the plate.

In Fig. 28 the pressure of the wind at numerous points of the surface is represented by several small arrows. These are made longer toward the forward edge, in order to indicate a fact, brought out by experiments, namely, that the pressures are more intense over the forward portions of an inclined plate. This is readily understood when we notice that the front edge of the plate receives the full force of the wind which, after having its direction of motion completely changed and made parallel with the surface, glides easily over the after portion of the plate without exerting much pressure. In dealing with pressures of this character we generally desire to consider the total pressure over the whole surface. Such a pressure will be called the *total normal pressure*, or simply *normal pressure*. By way of excuse for what may seem to be a misuse of the word normal in this connection, we may add that although we have already learned that when we include the effects of skin friction the wind pressure can not be strictly normal, that is, at right angles to the inclined surface; yet the friction effect is generally so small that we may for the present include it in the total pressure and still designate the combined effects by the convenient term, normal pressure, without serious inconsistency.

Center of pressure.—It is not enough to know that the total normal pressure on a plane is practically at right angles to the surface; we must also know the magnitude of the force and the point at which it acts. The point of application of the pressure is called the *center of pressure*, that is, the point at which, if all the forces be concentrated, their action produces the same effect as when the forces are distributed and act at every point of the surface. If the intensity of the pressure were the same at all points of the plate, then the center of pressure would be at the center of the surface. It was shown above, however, that with inclined surfaces the forces are most intense near the forward edges, therefore the center of pressure can not be at the center of the surface in such cases.

Many experiments have been made to determine both the magnitude and the point of application of the normal pressure on inclined surfaces of various kinds and for different wind velocities. Exact experiments are difficult to make, however, and the results obtained from various sources are more or less discordant with each other. In regard to the position of the center of pressure it is plain that if the forces are most intense toward the forward edge of the plate, as indicated in Fig. 28, then the center of pressure will be more or less forward of the middle point of the line, $A B$. (We have supposed the form of the plate represented by the line, $A B$, to be rectangular, with the front and after edges presented at right angles to the wind current.) Both the form of the plate and the

manner in which it is presented to the wind will have much to do with the location of the center of pressure. Without, therefore, attempting to indicate correctly the location of the center of pressure on the supposed rectangular plate, we may represent the total normal pressure of the wind on the plate by some such line as NO . The angle, AON , will be a trifle less than 90° , if we include the effects of skin friction. The center of pressure will be on the middle line between the right and left edges of the plate. It can not be otherwise, for there is no reason why the pressure of a uniform wind should be permanently unequal on the right and left halves of the plate.

Edge pressures.—The pressure on the forward edge of the plate may be represented by the line, EP , in the same way that NO has been found to represent the pressure on the under surface, AB . To ascertain clearly the total effect of the wind on the whole plate we must combine the forces, NO and EP . This is effected, according to the principles of mechanics, by prolonging the direction lines of the forces until they intersect and then constructing the parallelogram, $P'O'QN'$. $N'O'$ is made equal to NO , and $P'O'$ is equal to EP . The diagonal line, QO' , now represents the total effect of all the wind forces acting upon the plate, that is, the wind will tend to push the plate in the direction $O'Q$, with a force which is represented by the length of the line, $O'Q$. To hold the plate in equilibrium against the action of the wind it should be sufficient to introduce another force equal to $O'Q$ and opposed thereto, as the force $O'Q'$, for example.

Fig. 30 represents the action of the wind on the edge of a piece of cloth thickened by the cord in the hem to strengthen the material. The pressure of the wind on the rounded edge will tend to push the edge in the direction AP . The combination of this force, with the normal pressure represented by NO (only a part of the surface is shown) may be effected by means of the parallelogram of forces $O'N'QP'$. Here, again, the line $O'Q$ represents in magnitude and direction, the total effect of the wind on the surface in question.

In Fig. 30 the normal and the edge pressures are combined at the point O' , obtained by the intersection of the lines NO and EP prolonged. This method is adopted in order to simplify the diagram. We are not to infer that the resultant pressure necessarily acts through the point O' . The edge pressure, EP exists primarily as a tension in the cord in the hem of the cloth, and as such is communicated to the sticks of the kite. The precise manner of combining the forces in order to locate correctly the point of action, O' , of the resultant will require special attention according to the conditions of a particular case, and need not be now considered.

Resultant pressure.—We have already designated the pressure represented by the line NO as the total normal pressure. We will now adopt the expression *total resultant pressure*, or simply *resultant pressure*, as the name of the combined effect represented by the lines $O'Q$ in Figs. 28 and 30.

The important point it is designed to bring out in the foregoing treatment of the several pressures upon a plate is to show: (1) that the general pressure over smooth and extended plane surfaces may be regarded as practically normal to the surface, and (2) that the total resultant pressure on all surfaces (including the edges, sticks, struts, and other members, necessarily parts of the kite structure) is always inclined more or less away from a normal, as indicated by the lines $O'Q$, in the figures.

Thus far we have virtually supposed the plate to be perfectly flat, but kite surfaces, especially when made of paper or cloth, will rarely or never be quite flat, and the effects of curvature must, therefore, also receive our consideration.

Pressure on thin, curved surfaces.—The kind of curved surface commonly met with in kite work is simply the arched or bellied-out surface which results from the pressure of the

wind on the more or less loosely-fitted cloth or paper coverings. This looseness is oftentimes intentional, for the reason that experiments show that the total pressure on inclined arched surfaces is greater than on the same extent of flat surface. In Fig. 31, let AB represent a section of an arched surface, such as might exist in a kite. The curved line, AB , may be regarded as the path followed by a particle of air as it flows across the surface from the front to the rear edge. Here, again, so little is certainly known of the exact nature of the pressure of wind on such a surface that we cannot indicate its character correctly nor locate definitely the position of the center of pressure. In the case of a plane surface we found that the total pressure acted sensibly normal to the surface. In the case of arched surfaces we do not know certainly in just what direction the total pressure acts. Lilienthal, who has done so much to advance the art of flight with wings, has made a great many experiments from which he has deduced both the magnitude and direction of the pressure on arched surfaces.¹ His methods of experiment, however, and the results, especially in respect to the direction of the force, are affected by an error pointed out by A. v. Obermayer.² While it will scarcely be possible in a given case to predict what direction or at what point the total pressure is acting, yet we may state approximately that the center of pressure, generally, is forward of the middle of the arch, and the direction of action is at an angle of more than 90° to the chord of the arc. The line, NO , may be regarded as indicating the resultant normal pressure. The angle, ACN will generally be greater than a right angle. As in dealing with pressures on plane surfaces we may still consistently designate the total pressure on arched surfaces as the normal pressure, for the reason that it may be conceived to be the sum total of the forces acting normally at every point of the arched surface. The curvature which Lilienthal finds from his experiments to be the most effective is that which makes the height of the arch about one-twelfth of the chord.

The foregoing analysis of the wind pressures on surfaces has been carried out in considerable detail because these matters are of fundamental importance in arriving at a clear understanding of the action of the kite. One can not ignore them and at the same time proceed intelligently to improve and perfect kites.

Effect of waviness, or fluttering.—It often happens, especially with some forms of kites, that the cloth fails to remain taut and smooth, but forms a series of waves flowing in the direction in which the wind moves over the surface. A section across a surface of this character will have some such appearance as shown in Fig. 32. The action is oftentimes very pronounced, and the kite emits a comparatively loud sound, due to the rapid fluttering of the cloth. The effect of this is a matter of serious consequence. The wind presses strongly upon the windward sides of the waves, and thereby tends to push the surface along in the direction AB . Supposing the surface free of waves, the resultant pressure might be represented by such a line as OQ . If, however, the wavy condition prevails, the resultant pressure will take such a direction as OQ' .

Whirls, or eddy effects.—There is another respect in which the action of the wind on the kite may be objectionable in character, that is, may tend to depress the kite or drag it onward with the wind. In the absence of a better name this may be called the whirl or eddy effect. In some forms of kites a greater or less portion of the whole current of air affected by the presence of the kite is broken up into

¹ Der Vogelflug als Grundlage der Flugekunst. Otto Lilienthal. Berlin. 1889.

² Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Vienna. October, 1895.

numerous whirls and eddies. These may be formed when the air flowing against the kite is suddenly stopped, or when its movement is abruptly changed and diverted to a new direction. Angles and changes in the continuity of the surfaces such as formed by the presence of the cross stick in the Malay kite, for example, and other causes that prevent the air from flowing easily and by smooth changes of motion over and past the kite, will give rise to eddies. Whirls of marked character exist over the leeward surfaces of the kite. Strong eddies may thus be set up at numerous points adjacent to the body or surfaces of the kite. It is possible, and indeed quite probable, that some of these may remain nearly stationary in certain favorable spots. Such eddies or whirls, in a certain sense, may have much the same effect as obstructions to the flow of the air. Quite as much of an obstruction may be thus formed as if an excrescence of rigid material were placed on the kite at one of the points in question. In cellular kites generally the cells are virtually short tubes through which large streams of air must flow. Pronounced eddy formations within these tubes have much the same effect as real obstructions by which the flow of the air is as it were choked up.

We can not attempt here to analyze in detail the action of these eddies. The illustrations employed above to aid the mind in forming a conception of some of their effects are known to be faulty and imperfect and open to the criticisms of the exact physicist. Nevertheless, we perceive, by the aid of the comprehensive principle of the conservation of energy, that the power required to form these eddies and maintain the air within them in rapid motion must be derived by reaction from the kite and its string. The necessary reaction can be derived from the kite only when its angular elevation is depressed in consequence.

It, therefore, results that when eddy effects are present with a given form of kite, any modification that will eliminate or lessen the eddies will enable the same kite to obtain a higher elevation, other things remaining the same.

We have already said that the equilibrium of any form of kite depends upon the action of three forces, one of which is the wind pressure. In the foregoing discussion we have aimed to show the complex nature of the force that we call the wind pressure. We will next endeavor to show the conditions which exist when equilibrium is established between the forces in question. It is well known by experience that a condition of equilibrium is possible between the forces which act on a well built Malay kite, therefore we will first select this form of kite as the subject of our analysis. As seen from the front, the kite appears as shown in Fig. 33. The surface is far from being flat. The line AB is straight, but CD is bowed forward, as indicated by the curved dotted line, CD , Fig. 34. Owing to its looseness the cloth is bellied backward by the wind pressure so that in a cross section on a line such as cd the kite appears as shown in Fig. 34. Similarly a section on a line such as ab appears as shown in Fig. 35.

The kite is held in restraint by means of the bridle which is attached only to the midrib of the kite. In certain respects, therefore, we may regard the midrib as a fixed axis about which the kite may tilt laterally more or less. We will first consider the equilibrium of the forces on the lateral halves of the kite.

Lateral stability.—In the case of loosely fitted coverings, the arching back of the surfaces in the manner indicated in the drawing is very pronounced, and tends to increase the stability of the kite against tilting edgewise to the wind.

The two halves of the kite either side of the midrib, AB , must be made very carefully, equal and similar in all respects. When so made, the pressures, acting as indicated in Fig. 34, will just balance each other in a uniform wind, and the kite will then poise on what we may call an even keel. When, however, from variations of the wind, the pressure on one

side becomes greater than that on the other the kite is tilted over to some extent. The wing which momentarily received the greater pressure is moved laterally into a position of less inclination to the wind, and the intensity of the pressure is thereby diminished; whereas, the opposite wing being placed by the tilting in a position of greater inclination to the wind receives a corresponding increase of pressure and a balance between the opposing forces on the two wings is still preserved. If the covering of the kite is taut, so as to remain flat, the cross-section on cd will appear more nearly as shown in Fig. 36. A kite with such a surface is also able to preserve a condition of equilibrium between the pressures on the two wings, for the surfaces by tilting more or less assume different degrees of inclination to the wind, and within reasonable limits a condition in which the forces are balanced is possible at all times. The bending backward of the lateral wing surfaces so as to form a dihedral angle, as shown in Fig. 36, lessens slightly the angle of inclination of the surfaces to the wind. The lifting effect in such a case is, therefore, less than with the same surface not so inclined, for it is plain that if the two wings were bent backward to such an extent as to meet each other, all the lifting effect would be gone. The slight loss in lifting power which occurs for the reason here given is, as it were, the price we must pay for the stability imparted to kites of this type. The amount of bending backward ought to be no greater than is required to contribute a sufficient safe-working stability.

If, however, the cross stick of the kite is not bowed or inclined backward in any manner and the covering is taut, the whole surface of the kite will be sensibly flat. Made in this way, the kite will be found to have lost all its lateral stability. Tilting sidewise does not, as formerly, restore the balance of forces, for, with a flat surface, a change of inclination affects the pressure on the whole surface in the same way, and there is no tendency for the tilting to produce a balance between unequal forces on the two halves of the plane. A perfectly flat kite of a single surface can not, therefore, be made to fly of itself. Tails will be required and other artifices must be adopted to keep it poised in the wind in a flying attitude. Even approximately flat surfaces, however, rarely or never exist in kites as ordinarily made. The wind pressures bend the sticks and belly out the covering in nearly all cases to such an extent and in such a manner that at least a slight condition of automatic stability is imparted to the kite.

We have explained in the foregoing how the forces on the lateral halves of the Malay kite surface automatically balance each other, even when the wind pressures are not uniformly distributed. We will next consider the equilibrium of the forces in a longitudinal sense, or in the fore and aft dimension of the kite.

Longitudinal stability.—We have already mentioned that the kite is restrained by means of the bridle attached only to the midrib. We need to now consider how the pressures of the wind upon the cloth surfaces are communicated to the members of the structure and finally to the midrib itself. The fibres of the cloth can resist the pressure of the wind only by virtue of tensional strains. Referring again to Fig. 34, the arched surfaces of the cloth there shown are under considerable tension, which, at the midrib, E , is exerted in the directions of the tangents ET and ET' . There are similar tensional forces at C and D , which act upon the cord forming the perimeter of the kite. These strains are communicated in turn to the extremities of the two sticks, thus reaching the midrib directly or by means of the cross stick. The effect of the two forces, ET and ET' , is equivalent to a single force, EP . By a similar treatment of the reactions at the several portions of the kite frame, it will be found that all the forces may be concentrated upon the midrib. Let AB , Fig. 37, represent a side view of the midrib with the bridle

attached. From what has preceded, it will be easily understood that the magnitude and direction of the total resultant pressure of the wind upon the kite may be represented by such a line as QO . The center of gravity of the kite may always be found by well-known methods. Let g be the position of the center of gravity, then we may represent the weight of the kite by the line gw . The combined effect of both gravity and the wind is now found by means of the parallelogram of forces, $O'QRG$. The force represented by the line $O'R$ is the resultant effect of both the wind and gravity on the kite. The kite can be in equilibrium only when the string pulls in line with the force $O'R$ and through the point O . The string from the bridle must, therefore, take the position and direction shown, viz, $O'FL$, and the tension on the string must be numerically equal to the force $O'R$.

Diagram of forces.—Fig. 37 is a typical diagram of the action of the forces on any kite. Such a diagram, especially that part including the parallelogram, $O'QRG$, and the string, LF , will hereafter be designated as a diagram of forces. We have mentioned before that the force of the wind is the only force that varies independently; that is, the line OQ in the diagram requires to be made not only of different lengths, to represent, from moment to moment, the changing intensity of the wind force, but both the direction of the line, in relation to AB , and the position of the point O , are also constantly changing in correspondence with changes in the direction of the wind in reference to the kite. These changes of direction are partly real changes in the wind, but are also due to changes in the angle of incidence of the kite. The angle a in the diagram may, for present purposes, be regarded as the angle of incidence.

To follow a little further the action of the forces on the kite, let us suppose the wind pressure to increase in intensity without change of direction or point of application. Let the increased pressure be represented by the line $O'Q'$. The new resultant of the forces of wind and gravity will be the line $O'R'$. The pull of the string acting through the point O is now no longer able to just oppose and balance the new resultant $O'R'$. These two are inclined to each other at a slight angle, instead of being exactly opposite in direction. Resorting again to the well known method of the parallelogram of forces for combining the now unbalanced forces on the kite, we find that there exists a small unbalanced effect, such as indicated by $O'M$, which urges the kite forward and upward in the wind. (To avoid confusion, the lines of the parallelogram are omitted from the drawing.) The movement which results from the action of the force $O'M$ causes several changes of conditions, thus, the angle of incidence changes, the direction of the string is made steeper; the point of application of the resultant wind pressure shifts and the force also changes in direction. By means of these changes new conditions are established in which complete equilibrium of the forces again results.

We may now see the reason for using the bridle EFB . If the string were tied directly to the kite at F' , for example, the kite could be in equilibrium only when the resultant of the wind pressure and gravity passed through that point. Tied to the point F the point of intersection of the string with the kite can automatically shift and thus accommodate itself to numerous conditions. Moreover, the tension of the string acting at F and the wind pressing at O constitute a system of forces that are in stable equilibrium.

This advantage of arranging the string to draw from a point at a distance in front of the kite suggests that it be employed likewise to increase the lateral stability of the kite. For example, if EF , Fig. 38, represents the bridle as it is seen in the end view of the kite, the point F may be made fixed in reference to the kite by use of two steady lines attached to points on the cross stick, as at ff . Such, or an

equivalent arrangement, that produces a fixed point in front of the kite from which the string may draw, will be of special advantage in the case of single plane kites whose surfaces are very nearly flat.

For the sake of simplicity it has been assumed in all that precedes concerning the diagram of forces, that the angle of inclination of the total resultant wind force, QO , to the line, AB , can not be as great as 90° , which, for flat surfaces, represents an ideal condition of absolutely no edge resistance, skin friction, etc. This, however, may not necessarily be the case with arched surfaces, for we have already had occasion to point out, as shown in Lilienthal's experiments, that the total resultant pressure on certain thin arched surfaces may be inclined forward of the normal to the chord of the arch. Nevertheless, when ill effects such as those illustrated in Fig. 39 exist, the slight possible advantage gained by the effects of arched surfaces is more than offset by the defects that have been pointed out. Our assumption that the angle, QOB , is less than 90° for both flat and arched cloth surfaces as ordinarily found, can not, therefore, be much in error. Furthermore, there is positive evidence from the experience of every flyer of the Malay kites that the angle of the total resultant force, RFB , can not be as great as 90° . For, the angle, BEF , of the bridle is generally made at least 90° , and if RFB ever becomes as great as 90° it would mean that the lines FL and EF would coincide. A very slight acquaintance with kite behavior will convince one that this does not occur in practice. The direction of the string at FL always falls between the strings EF and BF .

Up to the present point we have proceeded to draw the diagram of forces as if the force, OQ , were fully known in magnitude, direction, and point of application. In practice this is just what we do not know. It is plain, however, that we may measure both the direction and the pull of the string at FL , and also determine its point of intersection with the kite. Furthermore, the weight and the position of the center of gravity of the kite are always determinable. Knowing, therefore, the resultant and one force for any given case, we are able to work the parallelogram of forces backward, as it were, and thus arrive at a complete knowledge of the unknown force, OQ .

Conditions that modify the angular elevation of the kite.—The direction of the string, FL , that is the inclination of the top end of the kite string to the plane of the horizon, considered in connection with the angle of incidence of the kite, is a fundamental datum in the analysis and comparison of the behavior of kites. When the string, from the ground to the kite is short and sensibly straight it will be noticed that the direction of the string at FL measures the angular elevation of the kite from the reel. Any arrangement or modification which can make this line steeper, other conditions remaining the same, will be an improvement, for it means that the kite will tend to fly that much nearer the zenith. Bridling the kite so that the angle of incidence a is smaller will, in general, cause it to fly more nearly overhead, but we do not wish to consider this case now for the reason that lessening the angle of incidence lessens the pull of the kite at the same time. It is designed to consider here only those modifications that will increase the steepness of the line FL without any change of the angle of incidence. We will reserve, for future consideration, the question as to what angle of incidence is best.

Let us observe the effects of the weight of the kite itself. In the parallelogram of forces, Fig. 37, the line $O'G$ represents the total weight of the kite. If the weight of the kite can be diminished then the line $O'G$ will be shorter in relation to $O'Q$, and a new resultant, $O'r$, will be formed having a steeper angle than the resultant $O'R$. As the kite string in the new condition must come into line with $O'r$ we see that

lessening the weight will cause the kite, other things remaining the same, to stand at a higher angular elevation. It will be noticed, also, that the resultant $O'r$ is longer than $O'R$; that is, the pull of the kite is greater.

There is another respect in which something may be done to increase the angular elevation of the kite. The line OQ representing the total resultant wind pressure on the kite is not at right angles to AB . The angle QOB is less than 90° . As has already been explained the influence which deflects the line away from the normal is the pressure of the wind on the edge surfaces of the kite. It may appear that a kite of the Malay type presents a very small extent of edge surfaces upon which the wind can act. However, such is often only seemingly the case. By referring to Fig. 39, which shows a sectional view of the kite on such a line as ab , Fig. 33, we notice that owing to the arching upward of the cloth in front of the cross stick CD , the greater part of the surface ACD , Fig. 33, is presented to the wind at a much greater angle of incidence than the rest of the surface. In a certain sense this triangular front of the Malay kite as it narrows out to the points C and D is little else than an edge surface, and the wind pressure thereon is of the same harmful character as upon real edge surfaces. The normal pressure on this surface takes such a direction as ON , Fig. 39, and when this force is combined with the other pressures that act more nearly at right angles to the kite surfaces, the total resultant is inclined away from the normal more than would be the case in the absence of these harmful pressures. Returning now to Fig. 37 we notice that any influence which causes the line QO to incline backward and away from the normal to the line AB will have the effect of giving a smaller angular elevation to the line FZ , when equilibrium of the forces exists.

The above study of the diagram of forces has thus far led to two noteworthy conclusions, namely: (1) that changes in the weight of the kite have a direct effect on the pull of the kite and cause the angle of intersection of the string with the kite surfaces to change, thereby changing the angular elevation of the kite; (2) that the blowing backward and upward of the loose cloth in front of the cross stick CD in kites of the Malay type has a very prejudicial effect upon the angular elevation of the kite. We may mention with these the following conditions which also tend to lessen the angular elevation of the kite, namely: (3) all pressures upon the edges of the kite; (4) the surfaces of the kite may flutter and take on a wavy character under the action of the wind. Attention was called to this ill-effect in a previous paragraph; (5) eddy effects.

Considerable attention has been given to the effects of edge pressure, whirls, waviness, etc., all of which cause the total resultant wind pressures on surfaces to take an inclined, rather than a normal, direction to the surface. In developing the kite so as to reach great elevations, any influence which tends to deflect the resultant wind pressure away from the normal to the kite surfaces tends to depress the kite away from the zenith by the same angular amount, and one most important point, therefore, in which to improve the kite is to diminish and eliminate, as far as possible, the edge pressures and all similar effects.

It is plain, therefore, as a result of the foregoing development of the ill-effects due to certain features of kite construction, that the expert designer must aim not only to make his kites as light as possible, but all waviness and fluttering must be suppressed, and all those influences which tend to deflect the direction of the total resultant pressure away from the normal be eliminated and diminished as far as possible.

We are now brought to the statement of a very important principle, the significance of which will more fully appear as the study of the action of the forces upon the kite is carried further. The principle has to do solely with the direction, rela-

tive to the kite, in which the wind pressure acts upon it. The magnitude of this force is a matter for separate consideration. The principle may be stated as follows: *The condition of ideal efficiency (that is, an efficiency of 100 per cent), in the action of wind forces upon a thin plane surface, obtains when the total resultant pressure is exactly normal to the surface.* The line QO' , Fig. 28, will, in the ideal case, form a right angle with CD and be in the plane of the paper. With material plane surfaces the angle $QO'P$ will generally be less, it can not be equal to or greater than a right angle. We have seen that with an arched surface the resultant may make an angle greater than 90° with the chord of the arc, but we are unable for the present to extend the above principle to the case of arched surfaces, as thus far no sufficiently exact knowledge of the direction of the resultant pressure exists to justify a statement of its limiting direction in the ideal case. In the development of the kite for the purpose of reaching very lofty elevations, the action of the wind upon it should exhibit the highest possible efficiency as the word is defined in the principle enunciated above. All those actions or effects which tend to incline the resultant away from the normal will cause the kite to be correspondingly depressed in angular elevation. Since for meteorological purposes, other things remaining the same, we aim to secure the maximum possible angular elevation for the kite, those effects which tend to depress the kite in angular elevation are of a harmful character and it will be convenient, hereafter, to employ the word harmful in this sense.

It will not be appropriate in the present article to discuss the diagrams of forces for different cases of wind force and direction, nor to develop the best arrangement of bridles, etc. Many experimental difficulties are encountered in seeking exact numerical solutions for ordinary practical cases, and many observations are required. The writer having indicated, in a general way, how the action of the forces affecting the kite may be studied, hopes that experts at work on the problem may test these ideas, pointing out errors and defects that doubtless exist, but especially that they may set about securing the observational and numerical data which are so much needed in order to convert the kite, hitherto almost without exception the toy of boys and men, into the highly efficient and useful piece of scientific apparatus which it seems destined to become.

FORMS AND CONSTRUCTION OF THE WEATHER BUREAU KITES.

The modification of the Hargrave kite, devised by Mr. Potter, and which we have called the diamond-cell kite, was extensively tested in our first experiments. The details of construction of this kite have been minutely given in the MONTHLY WEATHER REVIEW for November, 1895, and their repetition here will not be necessary. The kite is shown in Fig. 40, from which the construction will be understood. Numerous minor variations were made in the main proportions, and in the dimensions of the sticks, etc. The main object in view at that time was to reduce the weight of the kite as far as possible without impairing the strength to such an extent that it would break when severely strained in the wind. This was effected by tapering off the sticks and otherwise shaping them so that the greatest amount of material was concentrated at the points of the greatest strains. This form of kite is exceedingly simple of construction and possesses the advantage of being collapsible for convenience of storage or transportation.

One defect that may be pointed out in the diamond-cell kite consists in the presence of the comparatively sharp angles between the cloth surfaces where they meet at the side edges of the kite. The upper surfaces are greatly sheltered by the lower surfaces near these side edges, and we can readily perceive that eddies, whose harmful effects were pointed out

in a preceding paragraph, must be present to a serious extent. The writer devised and tested during December, 1895, two forms of multiplane kites, in which it was sought to avoid the objectionable effects of the sharp angles referred to above and still secure lightness of construction. Fig. 41 shows the first form tried. The result was a failure, so far as flying successfully was concerned. The two very small webs of cloth, *a a*, were the only vertical surfaces introduced, and the trial proved that the kite lacked those steady, stable qualities so generally found in kites of the cellular type. It was concluded that good results could be obtained by connecting the outer ends of the horizontal sustaining surfaces with cloth, so as to form a greater extent of side surfaces adapted to steady the motions of the kite.

The second form of kite carried out this idea. It is shown in Fig. 42. The only kite made of this kind was unsatisfactory because the frame work proved to be too light. Its flying qualities seemed to be as good as those of most of the kites tested at that time. The side planes are so steeply inclined as not to form the sharp angles found in the diamond kite.

Further experiments with these forms were resumed on different and better lines after the studies and experiments relating to the strength of the wire, the manner of splicing, measuring, reeling it, etc., were made.

While this work was in progress during the early part of December, 1895, a great variety of forms of kites were considered by the writer, even though time was not then available to make up and test them. The more important of these forms are shown in Figs. 43 to 46. Bearing in mind the conditions which ought to be satisfied by a good kite (p. 162), a brief mention of the points of advantage in the several designs will be sufficient.

Fig. 43 represents a Malay kite with an upper or superior sustaining surface, *a*. It will also be noticed that the bowed cross-stick, *C D*, is in front of the cloth. The object of this is to eliminate the harmful effects pointed out in connection with Fig. 39. The presence of the superior sustaining surface will cause the center of pressure to fall back of the mid-rib and thus tend to increase the lateral stability, which may be further improved by use of a bridle arranged according to the principle to which attention was called in connection with Fig. 38. In order to steady the kite a vertical web of cloth, or dorsal fin may be required. Both these modifications are shown in Fig. 44.

Fig. 45 indicates the application of a relatively weak propelling apparatus to the line beneath the kite. Such a device, if not too heavy in proportion to the lift of the kite and the thrust of the propeller, will, as shown, cause an angle to be formed in the string near the kite, so that the portion below the propeller is much more nearly vertical than the portion next the kite. The advantages of this will be more fully brought out when we treat later of the properties of the catenary or the curve formed by the kite wire or string. The motor is supposed to be operated by energy stored within, or by electricity, or possibly the necessary energy may be derived directly from the variations in the wind itself. It is well known that the wind constantly varies in force. Imagine the propelling arrangement to be driven by a steel spring, it is plain that with the aid of suitable mechanical devices every time the force of the wind increased the greater tension on the wire could be made to wind up the spring more or less. Or, the variations in the wind force might be made to flap wings in some useful manner. If the variations in the wind force proved to be inadequate the wire at the reel might be alternately pulled and slackened so as to produce considerable variations of tension. These ideas, it is believed, possesses some novelty and possible merit.

Fig. 46 shows the original idea from which the kite illustrated in Fig. 42 was evolved.

Mr. H. Chadwick Hunter of Washington, D. C., who interested himself in the kite work of the Weather Bureau, and who flew kites for his own amusement and outdoor exercise, introduced a noteworthy modification of the diamond-cell kite. This was in December, 1895. A Malay kite was cut in half lengthwise, and the triangular segments thus formed attached to the sides of a diamond kite, forming the winged kite shown in Fig. 47. Considerable additional sustaining surface is thus gained, with but a slight increase of weight. Several kites of this type were employed in the Weather Bureau work. In some the wing surfaces were made quite large. The results, however, were not so satisfactory. Seemingly, the best proportions are obtained when the greatest width of the triangular wing is not more than one-half the longitudinal dimensions of the kite. A greater width than this will answer well in light winds, but stronger winds are likely to disturb the symmetry of the kite as a result of unequal stretching of the material. Kites of this form took the highest angular elevation of any tested at that time, but experience showed that they could not be fully depended upon to stand as great extremes of wind force as the kite without wings. I think there is much merit in this kite, and it seems probable that by using a heavier and firmer grade of cloth for the wing surfaces, the effects of uneven stretching of the cloth will be less serious or of no consequence. Whether the corresponding increase of weight would detract seriously from the advantage gained by the addition of the wings can only be certainly told by experiments.

It is worth noticing that the amount of sustaining surface in a given kite is a fixed and invariable quantity, notwithstanding that the kite is called upon, or at least we wish it to withstand great extremes of wind force. Up to the present time no attempt appears to have been made to provide arrangements, automatic or otherwise, for increasing or shortening sail. Present practice in kite flying is like sending a yacht to sea with every sail set and without means for either reefing or furling them. The air ship, it is true, does not carry its sailors aboard, but it is not impossible that it may in the future. In the mean time inventive genius needs to provide some means by which the sustaining surfaces of a kite may be easily varied without proportionate variations of weight. One kite may thus be adapted to great extremes of wind force.

In the literature of kites we find the use of flexible surfaces strongly recommended, because, it is stated, the bending of the surfaces under gusts of wind eases off the severity of the strain and is otherwise attended with good effect. We have in this a means of automatically adjusting the expanse of sail to the force of the wind. The idea is good enough, in its way, but when we examine into the degree of flexibility provided and compute the diminution in pressure resulting from the maximum possible flexure, it will be found that the provisions ordinarily made will prove entirely inadequate and that the great advantages claimed are largely imaginary. The force of the wind at 30 miles per hour is fully nine times as great as at 10 miles per hour. The supposition that the flexure of a wing surface of a few degrees can contribute in any important degree to compensate for nine-fold variations in pressure, is plainly untenable. We shall have occasion later to discuss this point to some further extent.

The winged kite, described above, may easily be constructed in such a way that the wings may be removed or furled, and the amount of sustaining surface correspondingly diminished when strong winds prevail. This is perhaps a first step in the direction of providing a variable expanse of sustaining surfaces.

Mr. Hunter also devised and constructed the kite shown in Fig. 48. This was very successfully flown early in February, 1896. Other forms of kites proved to be superior, however, and more desirable in several respects.

It is important to notice that a kite almost precisely similar to the winged cylinder kite of Mr. Hunter was devised by Mr. W. H. Hammon, Forecast Official, in charge of the Weather Bureau office at San Francisco, Cal. Accounts of the first trial of this kite were published in the San Francisco Chronicle of April 2, 1896.

Fig. 49 is a drawing made from a photograph of this kite. Mr. Hammon dispensed with the ordinary bridle as a means of adjusting the string to the kite and adopted a novel bowsprit arrangement. His device is described in his own words as follows:

Instead of attaching the string to the kite by a bellyband, I use a stick, the end of which is attached to the backbone of the kite about two-thirds of the distance back from the front edge of the first cell and then passed diagonally through the cell and out at the bottom of the front edge, where it is also fastened and extends about 16 inches downward in this diagonal direction. The string is then attached to this lower end.

Speaking of securing automatic adjustability to winds of different force, he says this is also gained:

By attaching the bowsprit to the upper side of the cell only and then passing it through a rubber hose attached to the front edge of the lower side of the cell instead of to the cell itself. The string is then fastened to the hose instead of to the bowsprit. The point intended to be gained is that the cell will spread with a high wind, thus narrowing the surface normal to the wind and diminishing the strain upon the string, at the same time the bowsprit will be drawn further back in the hose, thus shortening the distance it extends below the lower edge of the kite, which causes the kite to hang more nearly parallel to the wind and thus diminishes the strains upon the string.

A kite of this form has not thus far been tested at Washington.

Attention has already been called to the tendency of the cloth covering of kites to form waves and to emit a comparatively loud sound caused by the fluttering. The manner in which energy may be wasted in this action has also been shown. The full significance of this action did not force itself upon me, at first, and many experiments were made with kites of various forms, the cloth of which, scarcely without exception, fluttered more or less at all times.

When the actual work of constructing improved forms of kites was resumed after the special investigations upon the best arrangement of kite line, reel, etc., were completed, the writer had become fully awakened to the importance and harmful effects of waviness, eddies, edge pressures, etc. After careful thought in the light of this knowledge, he was fully convinced that the simple rectangular cell of the regular Hargrave kite is a most excellent form of cross section of the cell. The sustaining surfaces are disposed in the position of maximum effectiveness, as are also the vertical side surfaces, whose special function is to steady the motions of the kite and contribute to the lateral stability thereof. The causes which can produce eddies are present in less degree than in many of the forms already described. The plan of construction practiced by Hargrave and followed by Mr. Potter does not, however, prevent fluttering of the cloth. From these considerations, however, I am led to the belief that the simple rectangular cell is already the best form we have as the basis of cellular and multiplane kites.

The problem was, therefore, how to improve this kite. To solve this problem the writer sought (1) to lessen the weight of the kite without loss of strength; (2) to reduce harmful edge resistances; (3) to suppress waviness and fluttering; (4) to lessen and eliminate eddy effects, and, finally, in order to increase the pull of the kite, other things remaining the same, (5) to arch the surfaces of the cloth.

The plan practiced by Hargrave of constructing the frame of the rectangular cells is shown in Fig. 50, so far as it can be made out from the general illustrations published by him in American Engineer, April, 1895. The details of the joints in Fig. 50 are due to Mr. Potter, and while the suggested con-

struction there indicated may be helpful to beginners, the point has no important bearing on the general plan of the frame. The important dimensions of a kite made according to this plan are indicated on the drawing. The sustaining surface of the kite is 24 square feet. The dimensions of the sticks (straight-grained white pine), where important and not shown on the drawing, are as follows:¹ All diagonal struts are $\frac{1}{2}$ inch square, shaved round and notched and cleated on the ends. The struts are firmly lashed together at points of crossing. All longitudinal sticks (six in number) are $\frac{1}{4}$ by $\frac{3}{4}$ inch, edges rounded. The four lateral longitudinal sticks are made narrow between cells. These sticks need not be made continuous. They were not so made by Hargrave. By making them continuous and stringing them with a complete system of diagonal ties made of fine, spring, phosphor-bronze wire, the frame of the kite is better able to withstand twisting and distortion. Made in this way the kite will prove to be an excellent flyer, and with winds of 12 miles per hour and over will be capable of reaching considerable elevations.

Improved construction.—A modified construction of this form of cell is shown in Fig. 51. This, so far as known to the writer, has not been employed or described before. Sufficient details are therefore given to enable others to use it, if desired.

Rectangular frames.—Slender frames, square dovetailed at the corners, as shown in Fig. 52, constitute the basis of the cells. The frames are made remarkably strong and rigid against forces acting in their own plane by means of the diagonal wire ties and the strut through the middle. The sticks for kites of from 24 to 40 square feet of sustaining surface are of $\frac{1}{4}$ -inch white pine, or spruce, $\frac{3}{4}$ inch wide, slightly more or less in proportion to the surface. All wire ties are of the best phosphor-bronze spring wire, 0.028 of an inch in diameter. To insert the wires so as to insure accuracy in the form of the frames, strips of wood are nailed to the top of the workbench so as to form a true rectangle, within which the slender frame will snugly fit. The end of a wire is passed through inclined holes at A. A small fragment of sheet tin is placed under the wire to prevent it from cutting its way into the wood when strained. One end of the wire is carried around the joint D and twisted in the manner shown. If not already done, the frame must now be placed within the rectangular form on the workbench. While held in perfect shape therein the remaining end of the wire is passed around the joint at C and secured by twisting while under considerable tension. The strut A B is generally only temporary. Any small stick answers the purpose, and it need not be secured within the frame in any way except as it is held by friction. The longitudinal truss on midrib of the completed kite generally takes the place and serves the purpose of the strut A B. The frame is completed when the wire E B F is inserted and fastened.

To secure the proper tension on the wires requires a little experience. Too much tension may easily be obtained, although if the knack of twisting both the wires equally is not possessed the joints may slip and the wire become too slack. With the right degree of tension the frames warp more or less out of true when taken singly. This is corrected when the frames are assembled.

In describing the best manner of splicing wire by twisting it was pointed out that both wires must be twisted around a common axis. The wire ties in the frame just described must be twisted in the same way. It takes but a moment to solder the twisted joints, and their strength is very greatly increased. The wire is also soldered to the pieces of tin at A, B. The wires at crossings are sometimes wrapped with

¹To avoid repetition here, the reader is referred to the MONTHLY WEATHER REVIEW for November, 1895, for minute details concerning the construction and joining of the framework.

finer wire and soldered; often, however, they are simply tied with fine strong waxed twine or thread.

The next member of the frame work is the piece employed to join the frames with each other at the corners. Fig. 53 shows the form of the stick and the tin angle pieces at the ends. The stick, originally $\frac{1}{4}$ inch square, is shaved down tapering and parallel to the diagonal to about $\frac{1}{8}$ inch at the ends. The tin angle pieces are secured to the ends of the stick by lashing with No. 22 gilling thread thoroughly waxed.

The cell.—The manner of connecting the frames with each other is shown in Fig. 54. Two connected frames constitute the cell, minus the covering. This is simply a long band of cambric, generally $\frac{1}{2}$ yard wide. After the strip of cloth has been torn to width and hemmed, the length is ascertained by stretching the edge around one of the frames, marking off, with pencil, where the stitching is to come. The opposite edge of the band is stretched around the frame in a similar manner and marked. The ends of the cloth are laid out smooth and pencil lines drawn across from the marks at the edges. These lines are overlapped and matched exactly. The cloth is then stitched on the mark and the seam finished as suits the taste of the operator. This method gives a cloth covering that fits perfectly. The tightness with which the cloth fits may be varied to suit circumstances. The cloth need not in any case be very tight.

The complete frame of the cell may be put together and the cloth slipped over afterwards. This requires some care to avoid pulling the cloth awry. I prefer to set up two of the frames on edge and connect them at the angles by means of the connectors shown in Fig. 53, three of which are simply laid in place between the frames with the band of cloth loosely on the outside. When the fourth is put in place the cloth comes under tension and all the parts hold together with some security. The corners may then be lashed together, as shown in Fig. 54. The edges of the cloth are secured to the cell by tacking it to the frames at intervals of several inches. I prefer, however, to secure it by sewing through the hem of the cloth and around the sticks of the frames. Stitches between one and two inches apart are sufficient. Fine bookbinders twine is generally employed for this purpose. Fully two square feet of sustaining surface is gained in a kite of thirty-two square feet, by this method of sewing, as it is not necessary to make the cloth overlap the frames.

Longitudinal truss.—Two cells joined by some sort of longitudinal truss make the complete kite. Several methods of trussing the cells together have been tried, but thus far, I think the strongest, most rigid and at the same time sufficiently light truss has not been developed. In the first kite made according to the new construction, the cells were connected at their four corners by a different plan than described above. Four long connecting pieces extending the full length of the kite were employed, and in another case two strong trusses similar to one shown in Fig. 55 were placed, one at either side of the kite. Either of the above plans of connecting the cells forms a very rigid and strong kite frame when reinforced with diagonal ties of wire. The principal objection to the arrangement of trusses just described is the fact that no good place results at which the bridle can be attached. Either an additional piece or supplementary truss must be placed in the central or median plane of the kite to which a simple bridle may be attached, or, in the absence of such a piece, a more complicated bridle must be rigged to draw from the lateral lower edges or corners of the cells. The first plan requires the addition of weight that ought not be necessary. The bridle of the second plan when under tension produces heavy compressive strains upon the frames of the cells, increasing the load these frames already carry as a result of the direct wind pressure upon the cloth. Neither plan is there-

fore quite satisfactory. The manner of joining the cells, illustrated in Fig. 51, was subsequently adopted and found more satisfactory. The truss itself is shown in Fig. 55.

The first kite made with a truss of this form is shown in Fig. 56. The slender, diagonal side braces *a a* and *b b*, Fig. 51, had not, at that time been introduced. Without them the kite lacks rigidity against forces acting at right angles to the plane of the truss. No difficulty on this account ever occurred with the kite shown in Fig. 56, which has seen a great deal of service, but the diagonal side braces are considered an improvement in most cases. Furthermore, in flying these kites in tandem mishaps caused by the main wire getting caught between the cells of the kite are prevented when the cells are connected with each other at their lateral edges. Very slender connectors are adequate both to stiffen the frame and to keep the wire from between the cells.

Advantages of construction.—The distinctive feature in the above described construction of the cells lies in the fact that the cloth is bound with wood at all edges. Being thereby made perfectly firm and rigid, it is found the cloth exhibits no tendency whatever to flutter or break up into waves. The kite flies in perfect silence, save a slight whistling of the wind over the wire ties. It is believed there is another important advantage in this construction, namely: a slender vertical strut, at *A B*, $\frac{1}{4}$ inch thick, is the only obstruction to the free flow of the air through the interior of the cell, except the fine, diagonal tie wires. Referring to the Hargrave construction, shown in Fig. 50, it may seem, at first thought, that the slender diagonal struts employed can have but very little harmful influence. When we remember, however, the effects of eddies and observe that the struts themselves and especially the relatively bulky knobs at the ends, where they thrust against the longitudinal members of the frame inside the cell, as also where they cross, are all fruitful causes of eddies, we are forced to the conviction that their elimination can not fail to prove highly beneficial. In the improved construction described, the minimum obstruction is offered to the easy flow of the air over all the surfaces and through the cells of the kite. In the old construction the edges of the cloth are thin and perhaps form a sharper cutting edge than the $\frac{1}{4}$ -inch rounded wooden frames with which the cloth is edged in the improved construction. I am inclined to think, however, that the thin edge of the cloth has only seemingly the advantage here. The contrast and comparison must be drawn between the thin, pliable, possibly loose and fluttering edge of cloth and the smooth, rigid, slightly thicker wooden edge. I am strongly convinced that the actual edge pressure upon the wood with even the bluntly rounded edges I have employed is but a trifle if any greater than upon the thin edges of cloth, as ordinarily found, and which is loosened up considerably in a very few minutes when exposed to the wind, even when originally made very taut.

The superiority of the new construction as brought out by the above analytical considerations is abundantly sustained by the results of exact observations and measurements. These will be presented in a later section of this article.

The principal objection I entertain to the construction which has been described is the weight¹ of the frame which, thus far, has been found to be some 20 per cent heavier than frames of similar size of the Potter-Hargrave construction. Even though handicapped by this greater weight, the performance of the kite, owing to the advantages already pointed out, surpasses in excellence that of any kite yet tested. On account of weight, however, the kite is not well adapted to work in light winds.

How further improved.—When the best general proportions

¹ The weight of the best and strongest kite thus far made is about 1.9 ounces per square foot of sustaining surface.

of a given kite have been fully brought out as a result of exact and systematic measurements upon the behavior of the kite, it is my purpose to critically analyze the strains upon every member of the kite frame, and proportion the strength of each member to the strain it must bear. The whole structure of the kite is a system of connected trusses, the strains upon the several parts of which may be easily determined by the methods so commonly employed in the construction of bridges and similar framed structures. This method of analysis can not fail to result in an increase of strength and decrease of weight, as all material will be employed to the best advantage.

The longitudinal truss, made to the dimensions indicated on the drawings, has, in some cases, proved too weak. At the present stage of the investigations considerable attention has been given to finding the best proportions for the distances between the cells and between the surfaces of a single cell, also, the proper width of the cloth bands. Much valuable observational data has been obtained, but further information is needed before a definite conclusion can be stated. When the best length for the longitudinal truss of a given kite is definitely known, I think it will be an easy matter to greatly improve the construction of the truss so as to secure adequate strength with the minimum weight. Thus far the sticks of the rectangular frames have been made of the same size throughout, notwithstanding that it is plain not only that some frames on a given kite are under greater strain than others, but that different parts of the same frame receive very different strains.

General remarks on constructions.—It may be added here that the improved construction while in fact very simple to a person with a few tools and gifted with real mechanical dexterity, does not claim to be of such a degree of simplicity that anybody can practice it. The novice with hammer and vise may be puzzled, for example, to neatly form the tin angle pieces shown in Fig. 53. Stringing the wire ties in the frame, just as they should be, may also prove perplexing. These operations take some time and require some skill, but when a cell is completed you have something that can stand the wind. The cloth is not going to work loose and give

trouble after the kite has been flying an hour or two in a stiff breeze, neither will the symmetry of the cell be impaired. The original construction of such a kite requires a little more time than other forms, but it retains its efficiency and symmetry a longer time in the end, and, because of this latter quality is less likely to distort and smash itself in a precipitate dash to the earth.

Aside from all these comments on the simplicity of construction, the object of paramount importance ever in the mind of the writer has been to secure the maximum attainable efficiency in the action of a given kite. Other things have been subordinate to this. The old-fashioned slide-valve steam engine, with fixed cut-off for example, is a marvel of simplicity compared with the complex, intricate, quadruple expansion engines of modern type, with balanced valves and automatic cut-off gear. What is the excuse for this complication?—efficiency. The improved engine will do twice the work, it may be, per pound of coal and barrel of water consumed. Just so with kites. One or two efficient kites, a moderate length of wire under an easy and safe-working tension, are all that are required to reach great elevations in fair winds. With kites of less efficiency to reach the same elevation, more kites, more wire, and far greater strains are necessary, increasing greatly both the danger of breaking the wire and the labor of winding it in. The incentive to fly kites to great elevations and thus excell all previous records is naturally very great. To do so on the principle that any kite is good enough so long as the result is attained, may be justifiable in the minds of some, but is hardly scientific. The writer believes that when kites of the maximum attainable efficiency are produced, and of which the strength and weight of the several members are duly and intelligently proportioned to the strains they must bear, just as is done in great bridges, only with far greater nicety, because with kites the factor of safety must everywhere be much smaller than with bridges—when these things are done, flights to astonishing elevations will follow easily of themselves and fewer reports will be read of kites breaking away with great loss of labor, wire, etc.

[To be continued in June Review.]

NOTES BY THE EDITOR.

LONG-RANGE FORECASTS.

On the morning weather map of June 13, as published by the Weather Bureau at Portland, Oreg., Mr. B. S. Pague, the local forecast official, calls attention to the fact that this map shows the first appearance in 1896 of the so-called type of summer weather conditions. Mr. Pague says:

In 1895 this summer type appeared on April 20, and the first winter type following that appeared on November 12. Winter weather, namely, rain conditions, have continued from November 12, 1895, to June 12, 1896. There are two well-defined types of weather on the Pacific Coast, and these have some fourteen modifications. The primary types are, first, the low area moving southward from Alaska along the coast line to the fiftieth degree of north latitude, sometimes lower, then passing eastward; at the same time the high pressure is off the California coast, and it finally moves eastward about the fortieth degree of north latitude. These conditions are peculiar to the winter season and give rain. The second type is represented by the low areas passing eastward about the latitude of Sitka, Alaska, and then moving southeastward on the eastern slope of the Rocky Mountains toward the Great Lakes, the high pressures moving from and along the California coast northward along the coast line to the fiftieth degree of north latitude, thence eastward. These conditions give fair and warmer weather.

The latter type is present for the first time this morning, for this year, and experience has shown that after the first appearance of the summer condition the weather is more likely to be fair than rainy. It is not to be understood that absolute dryness is now anticipated,

but rather that sunshine will predominate and the showers will be few.

The high pressure will move eastward over British Columbia and give fair weather and warmer on Sunday; Monday will be fair, and Tuesday promises to be fair and cooler, possibly some sprinkles of rain over western Washington and northwestern Oregon; Wednesday and Thursday should then be fair and warmer. Summer weather types produce weather such as is above outlined.

FROSTS IN CALIFORNIA.

Under date of May 5 Prof. E. W. Hilgard, President of the University of California and Director of the Agricultural Experiment Station at Berkeley, Cal., writes as follows:

The weather conditions in this State have been this year so extraordinary that meteorological observations and forecasts are more than ever called for, and are popularly demanded. Our experience with two of our stations this year has been a sore one, and will most seriously retard the settlement and modify agricultural practice in the districts concerned. At one station we find it necessary to completely remodel the varieties in our experimental orchard, about 50 per cent having proved useless for any practical purpose on account of their sensitiveness to even light frost, and the low temperatures of the summer nights; this at an elevation of only 1,400 feet, and in a locality where wholly unexpected. We are now actually carrying Russian apples and other hardy fruits as far south as the latitude of San Luis Obispo, as the only reasonable hope of the fruit industry in that region. In the great valley of California, too, the havoc wrought by the frost has been exceedingly heavy, and localized in the most puzzling man-

ner. Our San Joaquin Valley station, near Tulare, has suffered almost a total loss of its fruit crop, and even barley has been frosted so badly that it will make no grain, but had to be cut for hay. It is thus evident that the observations of extremes, as well as of means, should be most carefully made and faithfully kept; to insure this our stations should be equipped with self-recording instruments.

TOTAL SNOWFALL FOR THE WINTER 1895-96.

In the REVIEW and SUMMARY for 1895, Vol. XXIII, pp. 491 and 500, the Editor has given the annual snowfall for the so-called snow year, July to June, inclusive, for the ten years 1884-95. The following table gives the corresponding data for 1895-96. In a few cases, where records have been interrupted by discontinuance of stations, the values given by voluntary reporters have been used to complete an annual total. These snowfalls are also reproduced in Chart VII, but lines of equal snowfall are not drawn as the great distance of the stations apart and their diverse locations forbid reliance upon any system of interpolated lines.

Total snowfall at Weather Bureau stations.

(The snowfall is given for the so-called snow year, viz, from July 1, 1895, to June 30, 1896, inclusive.)

Station.	Inches.	Station.	Inches.
<i>Alabama.</i>		<i>Minnesota.</i>	
Mobile.....	T.	Duluth.....	40.4
Montgomery.....	T.	Minneapolis.....	27.0
<i>Arizona.</i>		Moorhead.....	43.0
Tucson.....	0.0	St. Paul.....	41.5
Yuma.....	0.0	St. Vincent.....	52.0?
<i>Arkansas.</i>		<i>Mississippi.</i>	
Fort Smith.....	5.0	Meridian.....	T.
Little Rock.....	3.1	Vicksburg.....	0.0
<i>California.</i>		<i>Missouri.</i>	
Independence.....	0.0	Columbia.....	27.7
Red Bluff.....	1.0	Hannibal.....	31.4
Sacramento.....	0.0	Kansas City.....	39.3
San Francisco.....	0.5	St. Louis.....	17.2
<i>Colorado.</i>		Springfield.....	25.7
Colorado Springs.....	41.2	<i>Montana.</i>	
Denver.....	58.3	Havre.....	38.5
Montrose.....	36.3?	Helena.....	58.2
Pueblo.....	18.8	Miles City.....	23.3
<i>Connecticut.</i>		<i>Nebraska.</i>	
New Haven.....	35.1	North Platte.....	20.8
New London.....	37.6	Omaha.....	30.8
<i>District of Columbia.</i>		Valentine.....	36.9
Washington.....	9.3	<i>Nevada.</i>	
<i>Florida.</i>		Carson City.....	27.3
Jacksonville.....	0.0	Winnemucca.....	41.1
Pensacola.....	0.0	<i>New Jersey.</i>	
Tampa.....	0.0	New Brunswick.....	5.8
<i>Georgia.</i>		<i>New Mexico.</i>	
Atlanta.....	0.2	Santa Fe.....	45.4
Augusta.....	T.	<i>New York.</i>	
Savannah.....	T.	Albany.....	51.6
<i>Idaho.</i>		Buffalo.....	72.0
Idaho Falls.....	53.7	New York.....	42.0
<i>Illinois.</i>		Oswego.....	74.9
Cairo.....	13.9	Rochester.....	93.8
Chicago.....	56.6	<i>North Carolina.</i>	
Springfield.....	16.3	Charlotte.....	1.1
<i>Indiana.</i>		Hatteras.....	T.
Indianapolis.....	46.8	Kittyhawk.....	5.0
<i>Iowa.</i>		Raleigh.....	1.2
Davenport.....	22.8	Wilmington.....	12.1
Des Moines.....	26.5	<i>North Dakota.</i>	
Dubuque.....	33.7	Bismarck.....	37.0
Keokuk.....	21.2	Williston.....	94.7
Sioux City.....	15.1	<i>Ohio.</i>	
<i>Kansas.</i>		Cincinnati.....	29.3
Concordia.....	15.7	Cleveland.....	48.2
Dodge City.....	5.3	Columbus.....	27.4
Topeka.....	11.4	Sandusky.....	25.2
Wichita.....	10.7	Toledo.....	63.7
<i>Kentucky.</i>		<i>Oklahoma.</i>	
Lexington.....	28.1	Oklahoma.....	5.7
Louisville.....	32.0	<i>Oregon.</i>	
<i>Louisiana.</i>		Astoria.....	6.0
New Orleans.....	0.0	Baker City.....	33.2
Shreveport.....	T.	Portland.....	9.1
<i>Maine.</i>		Roseburg.....	16.7
Eastport.....	57.5	<i>Pennsylvania.</i>	
Portland.....	77.1	Erie.....	71.8
<i>Maryland.</i>		Harrisburg.....	32.7
Baltimore.....	17.0	Philadelphia.....	14.8
<i>Massachusetts.</i>		Pittsburg.....	23.3
Boston.....	38.2	<i>Rhode Island.</i>	
Nantucket.....	32.0	Block Island.....	36.4
Vineyard Haven.....	27.8	Narragansett Pier.....	29.5
Woods Hole.....	33.9	<i>South Carolina.</i>	
<i>Michigan.</i>		Charleston.....	T.
Alpena.....	53.7	Columbia.....	0.6
Cheboygan.....	99.8	<i>South Dakota.</i>	
Detroit.....	54.3	Huron.....	20.1
Grand Haven.....	58.8	Pierre.....	27.3
Marquette.....	105.6	Rapid City.....	40.3
Port Huron.....	29.2	<i>Tennessee.</i>	
Sault Ste. Marie.....	110.7	Chattanooga.....	1.9

Total snowfall—Continued.

Station.	Inches.	Station.	Inches.
<i>Tennessee—Continued.</i>		<i>Washington.</i>	
Knoxville.....	3.5	East Clallam.....	37.0
Memphis.....	8.6	Fort Canby.....	5.3
Nashville.....	5.0	Neah Bay.....	20.0
<i>Texas.</i>		Olympia.....	3.0
Abilene.....	4.0	Port Angeles.....	18.0
Amarillo.....	12.8	Port Crescent.....	24.8
Corpus Christi.....	0.0	Pysht.....	25.0
El Paso.....	0.4	Seattle.....	10.4
Galveston.....	0.0	Spokane.....	46.6
Palestine.....	T.	Tatoosh Island.....	7.9
San Antonio.....	0.0	Walla Walla.....	17.0
<i>Utah.</i>		<i>West Virginia.</i>	
Salt Lake City.....	40.2	Parkersburg.....	32.9
<i>Vermont.</i>		<i>Wisconsin.</i>	
Northfield.....	89.8	Green Bay.....	32.5
<i>Virginia.</i>		La Crosse.....	36.4
Cape Henry.....	3.6	Milwaukee.....	51.4
Lynchburg.....	11.5	<i>Wyoming.</i>	
Norfolk.....	5.7	Cheyenne.....	50.3
		Lander.....	64.6

RÖNTGEN RAYS AND CLOUDY CONDENSATION.

Although meteorologists have not yet ascertained the exact process by which rain drops are made by Nature in her atmospheric laboratory, yet much light has been thrown upon the formation of the little globules of water that make up the ordinary mist and cloud. Among those who have worked upon the subject of the cloudy condensation of atmospheric moisture the most prominent names are: Coulier, of France, John Aitken, of Scotland, Robert, the son of Hermann von Helmholtz, and also Kiessling, both of Germany, and Carl Barus, formerly of the Weather Bureau, Washington. These physicists have shown that when moist air is cooled nearly to the dew-point the aqueous vapor begins to condense by preference upon the minute solid particles which we call dust floating in the atmosphere, no matter what the chemical nature of these particles may be; over the ocean the nuclei are mostly minute crystals of salt; in tropical lands and hot countries they are the spores and cells of debris of cells of vegetable origin; in the smoky atmosphere of large cities, the minute particles of carbon that go to form soot constitute the nuclei. It has not yet been clearly ascertained how the moist air would give up its moisture if there were absolutely no nuclei on which to initiate the condensation. Some consideration of this subject has been indulged in by Von Bezold and slightly modified by the present writer (see "The Production of Rain," in Frear's Monthly Journal Agricultural Science, 1892, Vol. VI, pp. 297-309) to the effect that in the ascending portions of every cloud there are regions that are supersaturated with moisture and that a strained molecular condition is thus produced that eventually and suddenly gives way accompanied by the production of the large drops of rain and electric phenomena. These views on the formation of cloud in the absence of dust were (probably quite independently) investigated by Mr. C. T. R. Wilson, according to an abstract published in Nature, Vol. LII, p. 144, of the paper read by him on May 13, 1895, before the Philosophical Society of Cambridge, England. Wilson found (as, indeed, Espy had done before him, see Espy's Philosophy of Storms, p. 35-36) that—

If ordinary air is started with, it is found that after a comparatively small number of expansions (due to the removal of the dust particles by the condensation that takes place on them) there is no further condensation unless the expansion exceeds a certain definite amount. With expansion greater than this critical value condensation again invariably takes place, and the critical value shows no tendency to rise, no matter however many expansions be made. The latest result for the ratio of the final to the initial volume, when the critical expansion is just reached is 1.258 (when initial temperature is 16.7° C. = 62.06° F.). This corresponds to a fall of temperature of 26° C. (46.8° F.) and a vapor pressure 4.5 times the saturation pressure for a plane surface of water. The radius of a water drop just in equilibrium with this degree of supersaturation is 0.0000065 cm. = 0.00000256 inch,

assuming the ordinary value of the surface tension to hold for drops of that size.

Quite recently Mr. Wilson, who holds the position of "Clerk-Maxwell student" at the University, Cambridge, England, has added another interesting chapter to our knowledge of this subject.

It will be remembered that in 1868 Tyndall observed that a dense cloud was formed when a powerful beam of light, either electric or solar, penetrated a tube full of dustless, pure vapor. The cloudy condensation thus formed was demonstrably due to the action of the radiation at the blue end of the spectrum and even of the rays beyond that. When freshly formed the cloud was of a brilliant blue, which, however, became white as the particles increased in size. (See Tyndall, Contributions to Molecular Physics, London, 1872.) It is difficult to believe that Tyndall's beam of light carried molecules into the tube, where they acted as dust nuclei to condense the moisture. But now Mr. Wilson has discovered a similar effect when the Röntgen rays are allowed to enter the tube. His account of these newest experiments is published in the Proceedings of the Royal Society of London for March, 1896, Vol. XLI, page 338, from which we make the following extract. Similar experiments had been contemplated in connection with the studies prosecuted at the Weather Bureau at Washington, but, in the absence of the necessary apparatus, their execution has been delayed.

In a paper on The Formation of Cloud in the Absence of Dust, read before the Cambridge Philosophical Society, May 13, 1895, I showed that cloudy condensation takes place in the absence of dust when saturated air suffers sudden expansion exceeding a certain critical amount.

I find that air exposed to the action of Röntgen's rays requires to be expanded just as much as ordinary air in order that condensation may take place, but these rays have the effect of greatly increasing the number of drops formed when the expansion is beyond that necessary to produce condensation.

Under ordinary conditions, when the expansion exceeds the critical value, a shower of fine rain falls, and this settles within a very few seconds. If, however, the same expansion be made while the air is exposed to the action of the rays, or immediately after, the drops are sufficiently numerous to form a fog, which persists for some minutes.

In order that direct electrical action might be excluded, experiments were made with the vessel containing the air, wrapped in tinfoil, connected to earth. This was exposed to the rays; the air was then expanded, the current switched off from the induction coil, and, finally, the tinfoil removed to examine the cloud formed.

As before, a persistent fog was produced with an expansion which, without the rays, would only have formed a comparatively small number of drops.

It seems legitimate to conclude that when the Röntgen rays pass through moist air they produce a supply of nuclei of the same kind as those which are always present in small numbers, or, at any rate, of exactly equal efficiency in promoting condensation.

THE TORNADO OF MAY 25, 1896, IN COOK COUNTY, ILL.

The Editor regrets that an excellent report by Henry J. Cox, Forecast Official, and Charles E. Linney, Observer, Weather Bureau (dated Chicago, August 7, 1896), on the tornado that passed over the northern edge of Chicago on May 25 was received too late for publication in the current REVIEW. In fact, the numerous illustrations make the report too voluminous for the REVIEW and more appropriate for a special publication. According to the authors:

The general atmospheric disturbance, which was attended by tornadoes in northeast Iowa and extreme northern Illinois on the night of

the 24-25th of May, 1896, did not appear very threatening on the morning of the 24th. Its center at the 8 a. m. (seventy-fifth meridian time) observation was in Alberta, with a trough of low pressure extending southward to Texas. At the p. m. observation the center had moved slightly eastward, the trough still extending far to the south, with a tendency to form a secondary over western Kansas and another over western South Dakota.

During the daytime of the 24th the barometer fell with moderate rapidity east of the trough, while a high area seemed to be moving into western Montana from the north Pacific Coast. Local conditions, as regards temperature, pressure, and moisture, seemed favorable for the formation of thunderstorms in the southeast quadrant of the low, although there was no apparent indication of unusually severe local storms. Our most severe local storms have frequently occurred when the weather map of a few hours previous showed but ordinary barometric gradient; under such circumstances the local conditions are likely to be sluggish as the storm center begins to move eastward.

This storm developed considerably in intensity during the night of the 24th, the center at the morning observation of the 25th being near Winnipeg, Manitoba. The chart of barometer change of the morning of the 25th shows rapidly falling barometer in front of the trough. This is the usual characteristic of such storms, the central depression increasing decidedly before the upper Lake Region is reached.

During the night of the 24-25th tornadoes occurred in northeastern Iowa and extreme northern Illinois, to be followed during the afternoon of the 25th by a tornado in the southeastern part of Lower Michigan. The main storm continued to increase rapidly during the 25th, its center being at White River, at 7 p. m., where the barometer had decreased to 29.14 inches.

Until the evening observation of the 24th but little rain had fallen in connection with this storm, the precipitation being in the shape of light showers throughout the Northwestern States, except a moderately heavy thunderstorm at Williston, N. Dak. Thunderstorms were general during the night of the 24th in the eastern Dakotas, Minnesota, Wisconsin, northeastern Iowa, northern Illinois, Indiana, and Lower Michigan, the local storms assuming tornadic proportions in the parts of Iowa and Illinois previously referred to. The path of greatest destruction of these severe local storms is shown in Chart G (not printed), but it is not assumed that this path was followed by any single tornado, nor that destructive storms occurred throughout the entire area indicated. There were probably three distinct tornadoes in Illinois in addition to those which occurred in Iowa between 10 and 11 p. m. of the 24th. The tornadoes in Illinois occurred at Egan City and Sugar River, at Elgin, and in Cook County, at about 1 a. m., 1.15 a. m., and 2 a. m., respectively, on the 25th.

The special tornado of Cook County moved at first easterly for about $1\frac{1}{2}$ miles, then southeast for three-quarters of a mile, then north of east and east for over 3 miles, when the path of destruction disappears. "A clear-cut path about one-quarter of a mile wide was visible for about $4\frac{1}{2}$ miles from the Des Plaines River to the north branch of the Chicago River." The tornado occurred about 2 a. m., with heavy lightning and thunder and rain. Most of the trees and debris fell toward the east or northeast. The twisting of houses and tree tops may, as it seems to the Editor, have sometimes been the result of a simple straight-line wind pushing obstacles forward in the direction of least resistance, rather than the result of a whirling wind. In other cases the locations of the debris indicate opposing northerly and southerly winds, and in these regions, therefore, a twisting tornado may be reasonably inferred.

The report is very full of the minor details of destruction, and the meteorological maps, charts, and diagrams are very satisfactory. In general, and in view of the great number of storms that invite investigation, one is forced to consider what items are worthy of observation and description in order to advance our knowledge of the origin of such storms, the laws that control them, and the method of avoiding them.

METEOROLOGICAL TABLES.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only the 8 p. m. observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation.

Table II gives, for about 2,400 stations occupied by voluntary observers, the extreme maximum and minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (....).

Table III gives, for about 30 Canadian stations, the mean pressure, mean temperature, total precipitation, prevailing wind, and the respective departures from normal values. Reports from Newfoundland and Bermuda are included in this table for convenience of tabulation.

Table IV gives detailed observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, meteorologist to the Government Survey.

Table V gives, for 26 stations, the mean hourly temperatures deduced from thermographs of the pattern described and figured in the Report of the Chief of the Weather Bureau, 1891-'92, p. 29.

Table VI gives, for 26 stations, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891-'92, pp. 26 and 30.

Table VII gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891-'92, p. 19.

Table VIII gives the danger points, the highest, lowest, and mean stages of water in the rivers at cities and towns on the principal rivers; also the distance of the station from the river mouth along the river channel.

Table IX gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division one may obtain the average resultant direction for that division.

Table X gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table XI gives, for 38 stations, the percentages of hourly sunshine as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is

indicated in the table by the letter T or P in the column following the name of the station.

Table XII gives a record of the heaviest rainfalls for periods of five and ten minutes and one hour, as reported by regular stations of the Weather Bureau furnished with self-registering rain gauges.

Table XIII gives the record of excessive precipitation at all stations from which reports are received.

Additional information concerning the tables will be found in the REVIEW for January, 1895.

NOTES EXPLANATORY OF THE CHARTS.

Chart I.—Tracks of centers of low pressure. The roman letters show number and order of centers of low areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the lowest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a trough or long oval area of low pressure.

Chart II.—Tracks of centers of high pressure. The roman letters show number and order of centers of high areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the highest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a ridge of high pressure.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all, by 0.0.

Chart IV.—Sea-level isobars, surface isotherms, and resultant winds. The wind directions on this Chart are the computed resultants of observations at 8 a. m. and 8 p. m., daily; the resultant duration is shown by figures attached to each arrow. The temperatures are the means of daily maxima and minima and are not reduced to sea level. The pressures are the means of 8 a. m. and 8 p. m. observations, daily, and correspond to Professor Hazen's system of reduction; the barometer is not reduced to standard gravity, but the necessary reduction for 30 inches of the mercurial barometer is shown by the marginal figures for each degree of latitude.

Chart V.—Magnetic phenomena. For further explanation of this Chart see the section on "Meteorology and Magnetism" in the text of the REVIEW.

Chart VI.—Depth of snowfall and limits of freezing weather. Total depth of snowfall is shown in inches. (T. = Trace.) The southern limit of freezing weather is shown by the frost line of minimum 40° F. — — — — and by the freezing line of minimum 32° F. — — — —

Chart VII.—The chart of snow on the ground is omitted for May, and instead thereof the total annual snowfall for the snow year 1895-96 is published, as tabulated on page 167.

Chart VIII.—Shows the path of the tornado of May 25, 1896, at Thomas, Oakland County, Mich.

Charts IX to XII.—Kite experiments at the Weather Bureau.

TABLE I.—Climatological data for Weather Bureau Stations, May, 1896.

Stations.	Elevation above sea level, feet.	Length of record, years.	Pressure in inches.			Temperature of the air, in degrees Fahrenheit.					Humidity and precipitation.					Wind.					Monthly temperature data since opening station.										
			Mean pressure, 5 a. m. and 5 p. m. +.	Mean reduced.	Departure from normal.	Mean max. and min. +.	Departure from normal.	Maximum.	Date.	Mean minimum.	Minimum.	Date.	Mean.	Greatest daily range.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Absolute maximum.	Year.	Absolute minimum.	Year.
New England.																															
Eastport.....	76	34	29.92	30.01	+.05	55.2	2.0	85	10 56	31	10 31	40	41	38	72	2.24	0.7	9	7,543	s.	36	e.	29	7	17	7	5.7	85	1896	29	1882
Portland, Me.....	100	25	29.88	29.98	+.01	55.0	1.5	92	10 64	35	10 46	35	35	45	72	3.21	0.4	9	5,328	s.	37	w.	18	8	13	10	5.7	94	1880	24	1892
Northfield.....	872	10	29.07	30.00	+.02	56.2	3.5	88	10 69	29	10 44	43	47	45	72	1.44	1.7	11	7,076	s.	42	sw.	18	5	17	9	5.9	90	1880	24	1892
Boston.....	125	26	29.88	30.02	+.04	60.3	4.1	94	10 70	38	10 31	51	51	47	62	1.68	1.9	9	7,062	w.	42	w.	18	10	11	10	5.8	97	1880	31	1882
Nantucket.....	14	10	30.03	30.04	+.06	54.2	2.2	75	10 61	38	10 47	26	45	48	83	2.35	1.2	10	8,464	sw.	37	ne.	6	15	9	7	4.3	86	1895	35	1890
Woods Hole.....	19	19	29.92	30.01	+.03	53.0	0.6	78	10 61	39	10 47	27	45	48	83	3.58	0.2	9	9,422	sw.	44	sw.	18	14	11	6	4.1	79	1895	34	1896
Vineyard Haven.....	10	10	29.92	30.01	+.03	50.4	2.9	86	10 68	38	10 30	33	45	48	83	4.13	1.0	8	9,422	sw.	44	sw.	18	10	11	6	4.1	79	1895	34	1896
Block Island.....	27	16	30.00	30.03	+.03	54.5	2.2	81	10 60	38	10 42	33	45	48	83	3.95	0.2	9	10,844	sw.	45	ne.	6	5	12	12	5.8	82	1895	35	1888
Narragansett Pier.....	15	15	29.91	30.02	+.02	57.8	3.2	92	10 67	33	10 48	42	45	48	83	3.35	0.3	8	10,844	sw.	45	ne.	6	5	12	12	5.8	82	1895	35	1888
New Haven.....	107	24	29.91	30.02	+.02	61.9	5.3	98	10 73	28	10 31	42	45	48	83	3.67	0.0	11	6,220	s.	32	w.	18	10	11	5	5.1	93	1896	30	1882
Mid. Atl. States.																															
Albany.....	85	23	29.92	30.01	+.03	63.6	4.3	91	10 74	42	10 33	34	50	65	1.05	1.6	12	6,399	s.	36	se.	26	8	16	7	5.7	92	1896	30	1878	
New York.....	314	26	29.70	30.03	+.03	63.8	4.3	91	9 72	43	10 33	38	53	74	2.01	1.2	11	9,586	sw.	52	sw.	19	10	12	9	5.4	95	1895	34	1896	
Harrisburg.....	377	8	29.63	30.03	+.05	66.0	5.8	98	9 73	45	10 35	43	56	74	2.99	1.7	12	5,171	w.	35	w.	18	11	10	10	5.7	93	1895	36	1891	
Philadelphia.....	117	26	29.92	30.04	+.02	67.2	4.9	98	11 77	45	10 58	39	53	66	2.27	1.0	8	7,800	sw.	36	nw.	11	8	9	14	6.4	96	1890	36	1896	
Baltimore.....	142	26	29.88	30.04	+.01	69.0	5.1	98	10 78	47	10 39	39	55	68	1.61	2.2	9	5,669	sw.	35	n.	5	5	12	14	6.6	96	1896	34	1876	
Washington.....	112	26	29.98	30.05	+.02	68.8	5.2	94	11 79	42	10 59	39	57	73	2.26	1.5	14	4,508	s.	54	sw.	28	8	9	14	6.0	96	1896	34	1876	
Cape Henry.....	23	23	29.93	30.05	+.04	69.8	5.0	98	11 78	44	10 62	32	57	73	10.61	6.7	16	se.
Lynchburg.....	685	25	29.33	30.05	+.04	70.8	5.1	94	11 82	50	10 66	36	62	77	5.01	1.1	14	2,755	ne.	27	nw.	26	8	11	12	5.6	97	1895	34	1891	
Norfolk.....	57	26	30.00	30.06	+.04	71.6	5.9	98	11 81	46	10 62	33	62	81	6.63	2.4	14	6,063	sw.	48	nw.	19	8	9	14	6.0	98	1890	38	1876	
S. Atlantic States.																															
Charlotte.....	773	18	29.24	30.04	+.02	75.2	6.7	95	11 86	49	10 64	29	58	64	1.08	2.7	10	4,777	s.	24	sw.	28	16	12	3	4.1	97	1895	33	1889	
Hatteras.....	11	16	30.07	30.08	+.05	70.8	4.3	98	11 76	51	10 66	31	64	83	1.50	3.1	9	8,722	sw.	40	n.	28	7	18	5	5.1	88	1891	47	1882	
Kittyhawk.....	9	22	30.05	30.08	+.08	68.9	3.1	92	11 76	44	10 62	27	62	83	4.23	0.5	12	9,818	sw.	44	ne.	7	15	10	6	4.2	94	1889	42	1892	
Raleigh.....	388	10	29.65	30.06	+.04	74.0	6.5	95	11 84	46	10 64	29	60	72	6.53	0.9	14	3,817	sw.	30	n.	26	10	13	8	5.1	98	1895	38	1891	
Wilmington.....	78	26	30.00	30.08	+.06	74.4	4.4	96	11 83	44	10 66	35	65	78	3.13	1.0	9	6,153	sw.	26	sw.	19	10	18	3	4.5	97	1889	38	1876	
Charleston.....	52	25	30.06	30.11	+.08	76.8	4.1	96	12 83	55	10 70	26	67	78	0.52	3.5	7	5,925	sw.	29	e.	7	10	19	2	4.4	96	1896	45	1894	
Columbia.....	9	23	29.93	30.05	+.06	77.6	5.6	99	11 89	51	10 66	36	67	78	3.66	0.6	11	sw.
Augusta.....	180	25	29.87	30.06	+.06	77.4	4.6	96	11 88	55	10 67	33	63	68	3.09	0.4	10	3,313	se.	30	nw.	31	10	12	9	5.1	100	1878	41	1894	
Savannah.....	96	26	29.99	30.09	+.05	77.6	4.1	97	11 87	55	10 68	31	66	75	4.30	1.4	8	5,416	s.	22	ne.	8	16	13	2	4.1	98	1878	44	1894	
Jacksonville.....	43	25	30.04	30.09	+.07	77.7	2.6	95	11 88	53	10 68	30	66	74	1.24	2.8	7	5,489	se.	29	se.	28	18	13	0	3.5	98	1878	46	1894	
Florida Peninsula.																															
Jupiter.....	28	9	30.06	30.09	+.07	76.2	0.1	85	11 82	61	10 70	19	68	76	2.83	3.0	12	7,191	se.	28	se.	21	10	14	7	4.8	93	1896	55	1894	
Key West.....	22	26	30.05	30.07	+.06	79.4	0.4	85	11 87	55	10 68	31	66	72	0.54	2.6	5	7,382	e.	28	se.	9	18	11	2	3.8	93	1881	63	1877	
Tampa.....	30	7	30.04	30.08	+.06	77.2	1.4	91	11 87	59	10 68	24	68	76	2.27	0.6	10	4,494	e.	27	nw.	21	9	21	1	4.6	93	1894	53	1894	
East Gulf States.																															
Atlanta.....	1,131	18	29.81	30.07	+.02	74.9	6.1	91	16 85	57	10 65	28	61	69	1.95	1.6	8	5,910	sw.	30	ne.	5	12	13	6	4.7	91	1896	39	1894	
Pensacola.....	56	17	30.00	30.06	+.04	76.6	2.5	90	16 83	54	10 70	32	68	74	2.81	0.5	7	6,029	sw.	33	sw.	28	12	11	8	4.5	93	1881	47	1892	
Mobile.....	57	26	30.02	30.08	+.07	76.0	2.5	93	24 84	63	10 69	26	68	76	1.96	2.4	6	5,407	s.	34	n.	28	8	15	8	5.1	98	1878	46	1889	
Montgomery.....	221	24	29.83	30.06	+.04	77.0	3.7	95	25 88	61	10 67	26	65	72	3.12	0.9	8	3,962	sw.	24	sw.	2	18	12	1	3.2	96	1875	44	1889	
Meridian.....	338	7	29.66	30.09	+.02	77.0	6.6	95	31 87	59	10 67	23	66	73	2.84	3.0	4	3,768	s.	26	nw.	28	5	21	5	5.5	95	1896	41	1896	
Vicksburg.....	254	25	29.73	30.09	+.01	77.2	4.2	93	24 86	61	10 68	24	65	71	2.40	2.5	5	4,652	sw.	25	w.	13	20	9	2	2.8	95	1877	46	1877	
New Orleans.....	54	26	29.99	30.05	+.06	77.8	2.7	92	24 86	65	10 70	19	68	77	2.80	2.1	11	5,094	se.	25	n.	28	18	11	2	3.6	92	1896	53	1891	
Port Eads.....	10	10	29.99	30.05	+.06	77.8	2.7	92	24 86	65	10 70	19	68	77	2.80	2.1	11	5,094	se.	25	n.	28	18	11	2	3.6	92	1896	53	1891	
West Gulf States.																															
Shreveport.....	249	25	29.71	30.07	+.01	77.2	2.9	94	26 87	59	10 68	25	69	79	3.94	0.2	6	5,171	se.	45	w.	1	11	14	6	4.7	101	1886	46	1892	
Fort Smith.....	481	14	29.42	29.92	-.02	74.0	4.7	91	31 85	54	10 31	40	64	73	5.99	1.3	13	5,510	e.	42	n.	22	10	10	11	5.4	98	1886	40	1892	
Little Rock.....	302	17	29.67	29.99	+.01	75.6	5.3	93	31 85	57	10 31	40	63	68	1.32	4.4	6	5,050	s.	37	nw.	30	10	11	12	8	4.9	93	1886	44	1892
Corpus Christi.....	30	10	29.92	30.00	+.03	77.9	2.2	86	30 82	65	10 74	15	73	86	1.94	1.3	3	12,864	se.	36	se.	1	7	13	11	6.0	96	1887	44	1888	
Galveston.....	42	26	29.96	30.00	+.03																										

TABLE I.—Climatological data for Weather Bureau Stations, May, 1896—Continued.

Stations.	Elevation above sea-level, feet.	Length of record, years.	Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.					Humidity and precipitation.				Wind.				Monthly temperature data since opening station.												
			Mean pressure, 8 a. m. and 8 p. m.	Mean reduced.	Departure from normal.	Mean max. and min. + 2.	Departure from normal.	Maximum.	Date.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean temperature of the day, dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Absolute maximum.	Year.	Absolute minimum.	Year.
Up. Miss. Val.—Con																															
Hannibal	534	39	29.34	29.90	+.01	70.4	88	80	47	15	61	34	58	69	7.14	3.1	12	7,826	s.	46	s.	37	11	13	9	6	4.7	94	1895	32	1875
St. Louis	571	36	29.37	29.97	+.01	73.0	91	82	56	15	64	34	62	74	9.12	4.5	15	7,891	s.	80	nw.	27	16	9	6	4.5	94	1895	32	1875	
Missouri Valley.																															
Columbia	7	7	29.30	29.90	+.04	71.2	86	90	48	29	60	35	58	72	5.61	0.3	15	6,431	s.	39	sw.	15	4	12	15	6.7	91	*	33	1891	
Kansas City	963	8	29.30	29.90	+.04	69.6	88	80	48	29	60	35	58	72	5.81	1.2	14	7,070	se.	32	nw.	27	5	19	7	6.0	90	*	36	1890	
Springfield, Mo.	1,324	11	29.56	29.93	+.03	69.5	91	86	47	22	60	32	60	74	11.46	5.4	13	8,669	s.	60	nw.	26	3	19	9	5.5	90	1893	34	1893	
Topeka	1,123	9	29.30	29.90	+.03	69.5	88	91	44	22	60	32	58	72	9.30	3.6	14	6,640	se.	30	nw.	27	5	12	14	6.5	97	1895	28	1875	
Omaha	1,123	25	29.70	29.88	+.07	66.9	88	76	48	19	58	26	55	72	9.51	5.1	18	6,640	se.	36	nw.	27	5	12	14	6.5	97	1895	28	1875	
Sioux City	1,165	7	29.30	29.90	+.03	64.4	88	88	43	19	55	31	43	53	6.39	3.0	9	9,381	s.	45	w.	24	6	10	15	6.5	95	1896	30	1896	
Pierre	1,470	12	29.25	29.78	+.11	63.6	81	89	42	17	52	37	44	54	0.30	2.0	5	8,806	nw.	44	nw.	23	4	20	7	5.9	101	1874	15	1892	
Huron	1,310	15	29.43	29.81	+.12	61.3	88	90	7	73	40	15	49	66	2.95	0.1	9	11,572	se.	52	s.	23	4	22	5	5.7	96	*	22	1889	
Northern Slope.																															
Havre	2,477	16	29.34	29.84	+.07	50.0	88	79	31	60	30	3	40	39	4.27	2.7	15	7,361	sw.	42	nw.	24	4	17	10	6.0	95	1886	*	18	1885
Miles City	2,372	19	29.33	29.80	+.11	55.2	88	78	5	87	32	15	43	37	6.92	0.7	13	6,597	n.	38	w.	2	7	11	13	6.0	98	*	24	1892	
Helena	4,108	17	29.74	29.96	+.03	46.6	88	75	28	55	29	17	38	36	2.25	0.7	14	6,770	sw.	36	sw.	25	9	12	10	5.6	89	1886	22	1885	
Rapid City	3,260	12	29.47	29.80	+.13	57.8	88	80	5	70	31	15	46	40	0.60	3.0	11	8,201	w.	49	w.	25	2	21	8	6.5	91	1894	20	1893	
Cheyenne	6,105	26	29.91	29.85	+.07	51.8	88	80	5	64	26	14	39	40	2.85	0.6	8	10,025	nw.	52	w.	11	4	21	6	5.9	88	1874	20	1893	
Lander	3,377	14	29.54	29.91	+.01	48.9	88	80	28	63	19	15	35	44	1.75	1.0	3	5,259	sw.	48	sw.	8	7	16	8	5.9	83	1893	30	*	
North Platte	2,820	22	29.96	29.85	+.07	62.4	88	89	6	74	34	14	51	39	1.47	1.2	10	9,350	se.	55	se.	6	6	21	4	5.6	97	1895	25	1890	
Middle Slope.																															
Denver	5,290	25	29.63	29.85	+.07	58.8	88	86	29	72	32	15	45	40	1.27	1.6	8	6,955	se.	42	e.	11	8	18	5	5.0	92	*	27	*	
Pueblo	4,713	8	29.15	29.83	+.07	62.2	88	82	27	73	33	2	47	45	2.35	0.7	4	6,899	sw.	38	sw.	8	11	14	6	4.8	93	1895	24	1893	
Concordia	1,410	12	29.84	29.84	+.11	67.5	88	80	24	77	43	2	58	36	6.46	2.2	14	7,123	s.	42	n.	31	5	16	10	6.0	100	1895	30	1893	
Dodge City	2,504	22	29.80	29.80	+.09	68.4	88	80	24	81	41	14	56	44	1.13	2.1	6	11,392	s.	49	s.	8	11	18	2	4.2	101	1896	24	1893	
Wichita	1,351	8	29.44	29.84	+.06	71.8	88	86	27	82	49	*	61	32	3.02	1.0	9	8,449	s.	39	n.	26	9	14	8	5.3	96	1896	34	1893	
Oklahoma	1,329	6	29.60	29.84	+.02	73.3	88	94	8	84	48	14	63	32	4.62	0.7	10	9,840	se.	48	w.	30	16	13	2	3.8	94	1896	38	1893	
Southern Slope.																															
Abilene	1,749	11	29.85	29.85	+.07	78.8	88	105	30	90	52	14	68	32	0.70	2.9	3	10,359	s.	30	sw.	18	14	11	6	4.3	105	*	42	*	
Amarillo	3,691	5	29.15	29.82	+.09	69.4	88	98	27	83	42	14	56	42	2.20	0.7	6	14,538	s.	60	s.	8	12	13	6	5.0	98	1896	30	1890	
Southern Plateau.																															
El Paso	3,767	18	29.80	29.80	+.05	75.0	88	102	29	90	43	10	60	43	T.	0.5	0	10,047	nw.	53	sw.	29	17	12	2	3.7	105	1886	40	1884	
Santa Fe	6,998	24	29.23	29.85	+.06	58.0	88	80	29	71	31	14	45	35	0.27	0.8	3	6,599	sw.	39	sw.	8	18	9	4	3.6	89	1887	24	1887	
Phoenix	1,106	22	29.88	29.83	+.03	74.4	88	110	28	90	45	11	59	39	T.	0.2	0	4,244	w.	24	sw.	15	24	3	4	2.0	90	1896	44	1887	
Yuma	1,411	21	29.67	29.81	+.03	76.8	88	112	27	92	49	11	62	43	T.	0.0	0	6,218	w.	38	nw.	29	26	5	0	1.6	112	1896	44	1887	
Middle Plateau.																															
Carson City	4,730	9	29.35	29.01	+.00	50.6	88	82	26	100	26	10	39	35	2.46	1.4	3	6,218	nw.	38	sw.	29	17	12	4	4.0	88	1889	22	1894	
Winnemucca	4,340	18	29.61	29.99	+.06	48.6	88	85	26	100	26	10	37	38	0.93	0.3	6	7,827	sw.	55	s.	22	9	13	9	5.3	96	1887	17	1887	
Salt Lake City	4,344	23	29.56	29.96	+.03	51.4	88	82	30	105	41	15	41	35	2.77	1.8	17	4,963	nw.	48	w.	1	3	14	1	7.4	93	1887	30	*	
Northern Plateau.																															
Baker City	3,490	7	29.38	29.93	+.02	46.4	88	79	29	56	26	18	37	33	2.28	0.8	17	3,944	nw.	27	sw.	20	3	9	19	7.5	85	1890	24	1891	
Idaho Falls	4,742	7	29.16	29.97	+.04	46.6	88	80	24	58	24	18	36	41	2.78	2.0	17	6,961	s.	43	s.	1	3	6	22	7.9	83	1894	22	1894	
Spokane	1,930	16	29.91	29.96	+.01	50.4	88	80	29	59	36	15	42	32	3.29	0.9	17	5,072	sw.	30	sw.	2	3	5	23	8.0	95	1897	29	1881	
Walla Walla	1,018	11	29.89	29.98	+.04	54.4	88	84	29	64	36	18	45	32	1.68	0.0	15	5,472	s.	30	se.	1	6	22	3	5.5	99	1897	35	1894	
N. Pac. Coast Reg.																															
East Clallam																															
Port Canby	179	13	29.80	29.06	+.04	49.7	88	81	29	57	33	15	40	41	4.02	1.7	19	8,929	w.	49	s.	3	5	12	14	6.8	84	1895	38	*	
Neah Bay		12																													
Port Angeles	29	12	29.97	29.00	+.01	49.0	88	86	29	58	33	15	42	26	4.90	0.4	18	5,003	sw.	38	w.	7	8	16	7	5.4	81	1894	30	1887	
Port Crescent																															
Pysht																															
Seattle	119	22	29.88	29.01	+.00	52.4	88	76	29	60	40	*	45	28	1.58	1.1	11	7,046	s.	23	sw.	10	5	10	16	6.5	90	1887	35	1886	
Tatoosh Island	86	13	29.91	29.01	+.00	48.4	88	81	29	62	35	2	44	15	3.25	0.7	17	8,387	w.	52	nc.	8	7	8	16	6.7	78	1895	30	1890	
Astoria		12		</																											

TABLE II.—Meteorological record of voluntary and other cooperating observers, May, 1896.

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alabama.						Arizona—Cont'd.						California—Cont'd.					
Alco†	94	59	76.0	4.05		Signal†	112	45	74.0	T.		East Brother L. H.	86	37	53.9	1.35	
Ashville†	96	62	79.2	2.35		Sulphur Spring Valley†	116	50	76.5	0.00		Edgwood*	84	25	43.4	7.20	30.0
Bermuda†	91	59	75.2	6.32		Texas Hill*	106	40	73.6	T.		Escondido	106	35	62.4		
Birmingham†	94	57	76.5	3.19		Tucson†	106	40	73.6	T.		Evergreen	106	43	62.6	0.13	
Brewton	96	58	76.6	3.20		Walnut Ranch*†	115	43	74.9	0.00		Fallbrook*	97	48	64.4	1.57	
Carrollton*†	89	60	73.6	4.88		Wells	95	27	57.8	T.		Folsom City*†				6.52	22.0
Citronelle†	91	65	77.1	2.78		Whipple Barracks†	100	56	76.6	0.00		Fortdyce Dam				3.64	
Claborne†	92	57	75.0	5.87		Willcox*				0.00		Fort Ross				2.05	
Clanton†	92	57	75.0	5.87		Arkansas.						Fort Tejon				4.81	
Cordova†	96	62	79.2	3.95		Arkansas City†	91	53	72.9	1.00		Georgetown†	91	32	53.6	0.00	
Daphne†	96	62	79.2	3.95		Beebranch†	91	53	72.9	4.35		Glendora				0.10	
Decatur†	97	59	74.2	4.00		Blanchard Springs†	94	55	75.8	2.57		Goshen*	102	40	59.4	4.87	
Demopolis†	97	59	74.2	4.00		Brinkley†	96	54	76.1	3.64		Greenville†	89	23	48.6	3.53	
Elba†	98	62	78.1	3.06		Camden†	98	54	76.0	1.16		Guinda				0.90	
Evergreen†	96	58	76.4	3.96		Camden†	98	54	76.0	1.08		Healdsburg*	90	40	55.0	2.24	
Florence†	98	55	75.0	2.98		Conway*	87	60	73.2	4.14		Hollister	97	36	56.7	0.47	
Florence†	98	55	75.0	2.98		Corning†	95	51	74.2	3.47		Hueneme				0.00	
Fort Deposit†	96	61	78.0	4.38		Dallas†	90	47	72.2	4.06		Humboldt L. H.				7.45	
Gadsden†	99	54	74.4	4.26		Dardanelle†				3.96		Hydesville†	72	35	51.9	4.50	
Goodwater†	97	57	75.2	3.80		Elon†	94	53	75.4	2.66		Indio*	110	58	78.4	0.00	
Greensboro†	95	62	76.6	3.07		Fayetteville†	88	48	72.4	7.60		Iowa Hill*†	87	38	54.0	4.58	
Hamilton†	98	59	78.1	4.44		Forrest†	93	54	75.6	3.04		Isabella*	104	34	63.1	0.04	
Healing Springs†	95	59	73.8	6.13		Fulton†				3.87		Jackson	84	32	51.9	2.11	
Highland Home†	92	51	75.7	2.70		Gaines Landing†				0.87		Jolon				0.09	
Jasper†	98	52	76.2	3.02		Helena†				3.86		Julian†	93	30	56.4	0.10	1.0
Livingston†	99	59	78.0	1.25		Helena†	98	58	78.2	3.78		Keeler*	99	44	68.4	0.15	
Lock No. 4.	92	52	73.4	3.03		Hot Springs†	98	54	75.8	2.79		Keene*	95	40	58.5	1.30	
Madison Station†	92	52	73.4	3.03		Hot Springs†				3.00		Kennedy Gold Mine	90	34	55.7	2.27	
Marion†	92	52	73.4	3.03		Hot Springs (near)				3.25		Kernville				0.00	
Mount Willing†	95	60	78.0	1.82		Jonesboro†	94	53	72.2	3.67		King City*	108	42	62.7	0.04	
Newbern†	92	63	76.6	3.41		Keesees Ferry†	93	46	72.3	4.02		Kingsburg*	100	55	68.3	0.05	
Newburg	95	52	74.4	2.44		Kirby†	92	51	73.8	3.90		Kono Tayee	86	39	56.9	1.69	
Newton†	94	57	76.2	1.30		Lacrosse†	90	50	71.8	2.65		Lagrange*	104	42	64.2	0.45	
Oneonta†	94	54	74.4	4.57		Latour				3.05		Laporte*†	79	22	43.5	9.32	25.5
Opelika†	92	56	74.8	1.63		Lonoke*	97	59	78.8	2.43		Lemoore*	102	46	67.3	0.00	
Oxanna†	91	54	73.2	2.72		Luna Landing*	92	60	76.5	0.76		Lick Observatory†	83	27	46.6	2.10	
Pineapple†	100	56	76.4	2.77		Madding†				1.75		Lime Kiln	105	38	66.1		
Pushmataha†	97	61	77.6	3.02		Malvern†	97	53	75.6	1.99		Lime Point L. H.				0.86	
Rock Mills†	92	55	74.2	4.16		Marvell				4.25		Lodi	94	38	60.4	0.82	
Scottsboro†	93	58	75.2	4.16		Mossville	84	51	69.6	8.35		Los Alamos†				0.00	
Selma†				1.28		Mount Nebo†	86	56	75.0	4.52		Los Gatos†	94	39	56.8	0.81	
Sturdevant†				3.13		New Gascony*	93	62	77.2	1.50		McMullin*†	102	40	64.5		
Talladega*	94	60	75.4	4.39		Newport†	93	50	74.0	5.24		Malakoff Mine*	88	34	52.2	6.61	
Tallapoosa Falls†				4.39		Newport†	93	50	74.0	5.20		Mammoth Tank*	114	61	82.9	0.00	
Thomasville	95	60	78.1	4.55		Newport†	95	52	74.4	4.85		Manzana	93	33	55.8	T.	
Tuscaloosa†	100	57	78.0	3.52		Ocala†	92	50	75.4	4.84		Mare Island L. H.				0.72	
Tusculum†	95	60	75.9	3.00		Ozark†	93	55	75.4	4.93		Merced*	101	45	62.6	0.29	
Union†	100	59	77.4	1.18		Pinebluff†	97	60	75.2	1.37		Middletown*†	96	35	56.0	2.23	
Union Springs†	99	60	77.2	4.98		Pocahontas†	80	52	72.2	3.18		Mills College				1.14	
Uniontown†	94	64	78.2	2.95		Prescott	95	51	76.7	2.82		Milton (near)*†	98	43	62.7	0.71	
Valleyhead†	90	49	71.7	4.75		Rison†	95	49	72.9	2.80		Modesto*	98	40	61.2	0.51	
Warrior†				3.24		Russellville†	93	52	74.2	3.85		Mohave*	102	42	60.8	0.00	
Wetumpka				4.26		Silver Springs†	90	47	70.4	7.06		Mokelumne Hill*				1.78	
Wilsonville†				2.45		Stuttgart†	94	56	74.9	1.70		Monterey*	86	48	58.6	0.42	
Alaska.						Texarkana†	94	55	76.3	1.78		Mountain Home				1.80	13.0
Killisnoo†	65	26	44.8	0.80		Warren†	96	56	77.0	2.00		Mount Frazier†				1.03	5.0
Kodiak*†	57	20	39.1			Washington*†	92	58	76.4	2.77		Mount Glenwood*	93	49	62.8	0.70	
Arizona.						Winslow†	82	48	68.2	6.55		Mt. Lowe Observatory				0.30	
Antelope Valley†				0.00		Witts Springs†	84	50	69.7	7.70		Mutah Flat†				0.52	
Arizona Canal Co. Dam.	105	42	72.5	0.00		California.						Napa†	98	36	50.1	1.10	
Benson*	105	60	79.4	0.00		Agnew	94	30	54.6	0.00		Needles	113	55	78.5	0.00	
Bisbee†	96	43	69.6	0.00		Arlington Heights	102	42	65.1	0.22		Nevada City†	86	29	51.2	4.88	
Buckeye†	107	42	73.5	0.00		Athlone*	95	48	67.0	0.12		Newcastle†	89	36	56.3	1.79	
Calabasas†	104	29	65.6	0.00		Azusa				0.36		Newhall*	103	45	67.1	0.30	
Casa Grande*	110	58	78.5	0.00		Ballast Point L. H.				0.00		Nordhoff†	106	33	62.1	0.00	
Dragoon Summit*	100	56	75.6	0.00		Barstow†	102	29	62.3	0.00		Oakland†	88	42	58.3	0.80	
Dudleyville†	106	42	72.1	T.		Bear Valley†				10.03	19.0	Ogilby*	118	46	83.6	0.00	
Eagle Pass*†				0.00		Berkeley	92	40	57.7	0.94		Oleta*	86	42	54.6	2.41	
Farley Camp†	106	43	73.2	0.00		Bishop†	98	25	56.5	0.04		Orangevale†	98	38	59.8	1.77	
Flagstaff†	98	22	52.8	T.		Bishop Creek*	92	35	62.0	0.03		Orland*	103	45	64.3	1.65	
Fort Apache	97	28	60.1	0.00		Boca*	85	26	43.7	3.10	6.0	Oroville†	95	44	63.8	2.08	
Fort Grant	100	42	68.6	0.00		Bodie†	82	12	38.5	0.49		Palermo†	99	35	61.5	0.80	
Fort Huachuca†	97	39	67.4	0.00		Bowmans Dam†				8.98	20.0	Paso Robles†	94	36	58.0	0.77	
Fort Mohave†	117	48	81.3	T.		Callente*	96	46	66.0	0.56		Peachland*	92	44	56.8	2.26	
Gilabend*	112	58	81.4	0.00		Calloway Canal†				0.16		Picacho	112	52	79.8	T.	
Gilabend†	116	45	77.6	T.		Cape Mendocino L. H.				8.03		Piedras Blancas L. H.				0.33	
Glendale	107	41	72.1	0.00		Cedarville†	83	23	47.2	3.51	2.5	Pigeon Point L. H.			</		

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
California—Cont'd.						Colorado—Cont'd.						Florida—Cont'd.					
Ravenna ⁸⁸	102	50	65.9	0.00		Fort Collins [†]	88	31	57.0	1.68		Avonpark [†]	95	59	78.0	3.08	
Redding ^{8†}	94	38	60.2	8.97		Garnett.....				0.02		Bartow [†]	93	58	77.0	2.83	
Redley (near) ⁸¹	101	50	69.8	T.		Gleneyrie [†]	81	30	55.2	1.24		Brooksville [†]	92	53	76.8	4.42	
Represa ⁸	90	40	60.2	1.62		Goldhill ⁸¹	78	26	51.4	1.63	8.8	Carrabelle [†]	90	61	76.4	1.90	
Rivista.....	91	37	59.2	0.67		Grand Junction [†]	94	35	62.4	0.51		Clermont [†]	100	59	80.4	2.12	
Riverside.....				0.58		Greeley [†]	88	32	58.4	1.42	2.3	Earnestville [†]	100	56	79.6	3.11	
Robertson's Mills.....				0.20		Gulch [†]	87	13	50.1	1.30	10.0	Emerson [†]	98†	54	79.5	3.90	
Roe Island L. H.....				0.40		Gunnison [†]	83	13	48.4	0.01		Eustis [†]	95	55	78.4	2.45	
Roseville (near) ⁸⁸	96	40	58.4	1.14		Holly.....				0.34		Federal Point [†]	95	55	75.4	0.68	
Rosewood.....	93	34	58.4	3.15		Holyoke ⁸				2.27		Fort Meade [†]	95	52	73.6	4.40	
Sacramento ⁸	96	39	62.3	0.92		Hugo ⁸⁸	92	30	58.8			Frostproof ^{8†}	92	65	76.0	3.30	
Salinas ⁸⁸	95	45	58.5	0.47		Hugo (near) ⁸	85	30	56.5	1.05		Gainesville.....	98	54	79.0	3.16	
Salton ⁸⁸	124	62	84.1	0.00		Husted [†]	87	28	56.0	1.25	1.5	Grasmere [†]	100	57	78.5	2.08	
San Bernardino [†]	102	38	64.2	1.00		Jamestown.....	79†	19†	48.9†	1.12		Kissimmee [†]	97	60	79.4	1.51	
San Jacinto [†]	103	38	64.6	0.22		Kit Carson ⁸¹	96	40	67.4			Lake Butler [†]	96	59	77.4	4.67	
San Jose ⁸	95	32	57.2	0.44		La Jara [†]	87	18	51.9	T.	T.	Lake City [†]	95	52	78.9	1.36	
San Leandro ⁸¹	90	50	60.5	0.91		Lake Moraine [†]	69	12	43.9	1.35	13.5	Lemon City [†]	91	58	79.5	2.32	
San Luis L. H.....				0.00		Lamar.....	98	38	68.0	0.55		Macclenny [†]	100	48	77.4	3.22	
San Mateo ⁸⁸	91	51	63.3	0.83		Laporte.....				2.25		Manatee [†]	96	54	75.5	1.75	
San Miguel ⁸⁸	96	41	63.0	0.24		Las Animas [†]	92	31	60.7	2.45		Merritts Island [†]	88	63	77.1	2.01	
San Miguel Island [†]	101	46	57.2	0.90		Lay [†]	87	12	50.7	0.66	T.	Milton [†]				2.70	
Santa Ana ⁸⁸	105	60	75.4	0.00		Leadville (near) ^{8†}	70	22	42.0	0.77	11.0	Mullet Key [†]	88	67	78.2	3.32	
Santa Barbara ⁸	98	42	61.4	0.08		Leroy [†]	90	31	59.8	2.36	T.	Myer [†]	90	60	76.7	0.92	
Santa Barbara L. H.....				0.18		Longmont [†]	95	33	60.4	5.60		New Smyrna [†]	87	52	72.6	0.97	
Santa Clara ⁸⁸	88	40	56.3	0.32		Longs Peak.....	78	19	47.4	1.21	5.0	Oakhill ⁸¹	88	68	77.3		
Santa Cruz ⁸	95	34	57.2	1.66		Loveland.....				1.79		Ocala ^{8†}	93	51	76.9	1.53	
Santa Cruz L. H.....				0.90		Manhattan.....				1.67		Orange City [†]	96	63	79.0	4.12	
Santa Maria.....	102	37	59.1	0.03		Meeker [†]	90	17	52.4	0.64	0.8	Orangeburg.....	94	54	74.8	4.08	
Santa Monica ⁸⁸	99	53	68.7	0.00		Millbrook [†]	84	20	53.0	0.19	0.5	Orlando [†]	95	57	77.6	2.71	
Santa Paula ^{8†}	106	40	63.6	0.00		Minneapolis [†]	100	38	66.5	0.80		Oxford ^{8†}	97	60	78.2	3.30	
Santa Rosa ⁸⁸	92	49	64.1	1.45		Montrose.....	92	27	63.2	0.13	1.3	Plant City [†]	98	54	77.8	2.07	
Saticoy [†]				0.00		Moraine [†]	74	21	47.0	1.62	2.0	Quincy [†]	98†	60†	75.0†	5.08	
Shasta.....				9.17		Ouray [†]	75	22	45.0	1.30	12.0	St. Francis [†]	94	53	73.4	2.90	
Shasta Springs [†]	95	38	49.0	6.45		Pagoda [†]	85	15	50.2	0.75	2.5	St. Francis Barracks.....	90	57	74.4	2.05	
Sneddens Ranch ^{8†}	88	28	65.2	0.57	2.0	Paonia [†]				0.67		Tallahassee [†]	94	52	77.4	2.60	
S. E. Farallone L. H.....				0.30		Parachute [†]	91	29	59.2	0.21		Tarpon Springs [†]	85	56	74.6	2.12	
Stanford University.....	94	34	56.2	0.40		Pinkhamton ⁸¹	74	20	48.4	0.87		Georgia.					
Stockton ⁸	95	41	59.8	0.96		Redcliff.....				1.17	4.7	Adairsville [†]	93	53	74.3	3.18	
Summerdale [†]	81	23	45.8	1.45		Rico [†]	82	30	47.0	0.35	2.0	Alapaha.....	98	51	77.8	0.85	
Susanville [†]	85	29	51.4	2.22	T.	Riverbend ⁸⁸	90	18	54.2			Albany [†]	98	56	79.4	2.14	
Sutter Creek ⁸⁸	80	30	51.4	2.68		Rockyford [†]	94	33	62.9	1.12		Allentown [†]	100	56	79.4	2.34	
Tecarte Dam ⁸¹	101	22	56.0	0.15		Ruby [†]				2.70	27.0	Americus [†]	100	58	79.6	1.85	
Tehama ⁸⁸	95	47	62.8	1.23		Saguache [†]	70	20	44.0	0.00		Athens.....	95	56	75.3	1.78	
Teton Ranch.....				0.48		St. Cloud [†]				1.30		Bainbridge.....	100	55	79.4	1.05	
Templeton ⁸⁸	100	43	61.1	0.54		San Luis [†]	90	22	52.6	0.24		Blakely ^{8†}	95	59	76.4	1.73	
Trinidad L. H.....				5.72		Santa Clara ^{8†}	86	28	53.6	1.10	11.0	Brag [†]	101	51	77.4	1.36	
Truckee ⁸⁸	82	28	43.7	0.54	3.0	Selbert [†]				0.28		Brunswick [†]	80	51	76.1	1.60	
Tulare ⁸				0.15		Sherwood Ranch.....	76	13	47.2	0.40		Camak.....	97	52	77.0	2.32	
Tulare ⁸	110	38	66.5	0.14		Smoky Hill Mine [†]	79	23	49.2	1.15	10.0	Canton [†]				1.55	
Turlock ^{8†}	102	34	66.2	0.72		Stamford ⁸¹	78	30	45.0	0.80	8.0	Clayton [†]	92	47	71.2	3.70	
Ukiah [†]	93	34	55.4	2.94		Sulphur Springs [†]	84	17	48.0	1.24	4.0	Columbus [†]	97	60	77.1	2.14	
Upper Lake.....	92	35	55.5	2.07		Surface Creek [†]	91	25	55.2	0.67	T.	Cordele.....	97	56	76.9	1.80	
Upper Mattole.....				9.91		Thon [†]	90	26	56.1	0.81	2.0	Covington.....	96	55	75.5	1.86	
Vacaville ⁸¹	96	48	61.8	1.25		T. S. Ranch [†]	89	30	58.4	0.21	3.0	Dahlonega [†]	89	50	70.4	5.05	
Ventura [†]	100	34	57.0	T.		Twin Lakes.....				1.35		Diamond [†]	91	47	69.7	2.35	
Volcano Springs ⁸⁸	122	62	89.4	0.00		Vilas.....				1.97		Eastman.....	100	44	76.3	1.34	
Walnut Creek.....	99	41	62.0	0.33		Walnut [†]				1.30		Elberton [†]	95	55	76.4	2.10	
Washington ⁸¹	93	30	53.0	6.68	T.	Watkins ⁸¹	68	32	47.6		1.0	Fleming [†]	96	49	76.0	6.16	
Westpoint [†]				2.20		Wray [†]	93	32	63.4	1.64		Fort Gaines.....	96	58	78.0	4.58	
Wheatland [†]	96	37	60.6	1.18		Yuma.....				2.06		Gainesville.....				1.53	
Williams ⁸⁸	94	45	64.1	0.36		Connecticut.						Gilleville [†]	94	56	74.7	4.08	
Willows ⁸⁸	92	40	64.5	0.88		Bridgeport.....	95	37	62.4	4.81		Griffin [†]	97	59	78.4	1.14	
Wilmington ⁸⁸	95	57	67.9	0.00		Canton [†]	89	32	60.2	2.93		Hephzibah ⁸⁸	92	60	76.6	1.30	
Wire Bridge ⁸⁸	95	44	62.0	2.46		Colchester.....	91	32	61.0	4.97		Lagrange [†]	97	53	76.0	1.53	
Yerba Buena L. H.....				0.77		Falls Village.....				3.39		Leverett [†]	97	51	76.0	1.30	
Yreka [†]	80	37	51.4	2.75		Greenfield Hill.....				4.15		Lumpkin [†]	97	60	78.2	1.17	
Yuba City ⁸⁸	94	50	64.8	0.90		Hartford ⁸				2.51							

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	Ins.	Ins.
Chesterfield†	80	16	45.9	2.51	1.0
Coeur d'Alene	80	33	48.3		
Corral††	70	22	43.8	2.52	1.5
Dairy†	81	16	43.7	3.31	
Downey†	80	22	46.0	3.32	0.5
Fort Lemhi†	86	20	47.0	1.82	5.0
Fort Sherman†	81	32	49.0	3.11	T.
Fraser†	82	23	45.9	4.20	1.0
Grangeville	78	22	45.0	4.94	15.3
Idaho City†	81	23	44.6	6.26	8.2
Idaho Falls					10.2
Kootenai†	83	26	51.6		
Lake†	70	14	36.8	2.50	25.0
Lewiston†	93	34	54.0	1.70	
Lost River†				2.24	4.0
Martin†	78	13	43.0	3.45	
Minidoka†	91	12	47.6	3.08	2.5
Moscow†	84	31	47.4	3.00	6.9
Murray†	82	29	45.8	5.07	T.
Nampa	81	27	49.8	3.19	T.
Oakley†	83	23	49.4	1.30	7.0
Orchard†	83	28	48.8	2.86	
Paris†	80	15	44.5	2.37	
Payette†	88	29	55.6	2.30	
Pollock†	85	32	53.0	2.80	
Roseberry†	74	21	43.4	0.98	3.0
Salubria†	90	37	51.8	4.86	3.0
Soldier†	75	23	43.2	2.19	6.0
Swan Valley†	82	11	45.6	3.71	9.5
Warren†	78	16	40.5	3.47	
Illinois—Cont'd.	°	°	°	Ins.	Ins.
Oswego†	89	48	66.1	7.52	
Ottawa†	94	46	68.7	4.24	
Palestine†	92	47	70.8	3.90	
Paris†	98	50	72.6	5.92	
Peoria†				5.09	
Peoria†	93	49	72.2	5.74	
Philot†	96	40	68.9	3.99	
Plumhill††	94	52	71.1	6.96	
Rantoul††	93	51	68.6	4.95	
Reynolds	88	46	67.6	5.69	
Riley†	89	45	65.6	5.04	
Robinson†	92	55	69.0	3.93	
Rockford†	92	50	69.0	6.31	
Rose Hill††	94	58	71.4		
Roundgrove†	93	43	68.4	4.34	
Rushville	91	47	70.3	4.31	
St. Charles††	90	48	66.7	5.77	
St. John††	94	59	73.7	9.46	
Scales Mound†	90	44	67.4	7.97	
Streator†	90	43	68.8	5.98	
Sycamore††	89	48	66.2	3.80	
Tiskilwa††	92	50	67.2	4.71	
Tuscola††	93	46	69.2	4.79	
Walnut†	90	49	68.7	4.12	
Warsaw†				3.05	
Wheaton†	50	35.2	7.07		
Winnebago†	88	44	66.0	6.50	
Zion†	88	41	63.0	8.35	
Indiana	°	°	°	Ins.	Ins.
Anderson†	90	47	68.7	3.86	
Angola†	91	45	67.6	4.35	
Bloomington†	93	48	70.2	5.12	
Bluffton†	92	45	68.3	5.63	
Butler†	94	46	69.9	2.75	
Cambridge City†	90	45	67.4	2.85	
Columbia City†	89	50	68.0	4.33	
Columbus†	94	46	68.9	1.97	
Connersville†	92	47	68.6	3.35	
Delphi†	87	44	64.8	4.57	
Edwardsville††	90	54	72.4	4.59	
Evansville†	94	49	71.7	5.39	
Farmland†	89	48	68.0	4.49	
Franklin†	91	58	69.8	2.23	
Greencastle†	88	53	69.0	5.19	
Greenburg				3.75	
Hammond†	94	44	66.7	3.95	
Huntington	91	49	68.0	6.56	
Jasper†	93	49	70.9	6.52	
Jeffersonville	91	52	71.8	4.87	
Knightstown†	91	46	69.6	4.56	
Kokomo†	93	50	69.9	4.90	
Lafayette†	92	45	68.0	4.71	
Logansport†	89	49	68.4	4.23	
Madison†	93	52	71.4	5.63	
Marengo†	94	49	70.3	3.80	
Marion†	90	49	69.0	3.64	
Mauzy†	91	46	68.9	3.52	
Mount Vernon†	95	51	72.6	6.24	
Northfield†	92	47	68.4	3.50	
Princeton††	94	48	69.2	8.55	
Rockville†	93	47	69.5	4.65	
Rushville†				4.71	
Scottsburg†	91	52	70.6	6.51	
Seymour†	92	52	71.0	3.59	
South Bend†	90	45	67.3	3.01	
Sunman	91	48	68.6	3.37	
Syracuse†				3.43	
Terre Haute†				3.41	
Valparaiso†	90	46	66.7	6.42	
Vevay	94	50	72.8	6.27	
Vincennes†	96	49	73.0	4.84	
Worthington†	90	51	70.6	4.09	
Indian Territory	°	°	°	Ins.	Ins.
Eufaula†	102	50	77.4	7.76	
Healdton†	103	52	78.6	2.08	
Kemp†	98	48	76.0	1.87	
Lehigh†	98	41	72.6	8.74	
Purcell†	92	42	72.0	5.36	
Tahlequah†				5.90	
Tulsa†	98	50	73.2	10.51	
Iowa	°	°	°	Ins.	Ins.
Adair	89	43	66.4	5.49	
Afton	89	45	64.5	6.85	
Algona†	90	48	63.2	6.07	
Alta†	86	41	63.7	7.99	
Amara†	89	45	66.7	7.55	
Ames†	88	44	63.4	6.18	
Atlantic†	86	37	63.4	6.32	
Atlantic (near)	86	43	63.4	6.72	
Audubon	86	41	63.4	7.66	
Belknap	89	46	65.8	5.91	
Belle Plaine	89	43	65.0	4.01	
Bonaparte†	90	44	62.9	7.54	
Carroll	87	39	64.2	9.87	
Cedarfalls†	89	35	65.5	6.24	
Iowa—Cont'd.	°	°	°	Ins.	Ins.
Cedar Rapids†	100	46	69.8	3.99	
Centerville	92	48	68.3	7.71	
Chariton	87	46	66.5	7.36	
Charles City†	89	44	64.9	7.34	
Clarinda†	83	42	63.8	7.48	
Clinton	92	46	69.0	4.90	
College Springs	87	48	66.6	7.89	
Corning†	88	42	66.2	6.27	
Council Bluffs				11.15	
Cresco†	86	42	62.9	6.74	
Decorah†	89	42	64.4	3.90	
Delaware†	88	45	64.8	9.57	
Denison†	87	42	63.8	8.16	
Dows	86	41	63.7	7.61	
Eldora	85	41	65.0	6.73	
Elkader†	92	42	65.6	5.58	
Estherville	89	41	62.6	4.53	
Fairfield†	89	40	66.1	7.42	
Forest City	87	39	63.0	6.64	
Fort Madison††	93	55	71.8	6.29	
Galva†	86	43	64.2	7.44	
Gardengrove	89	40	65.2	8.62	
Glenwood†	94	34	68.0	10.03	
Grand Meadow†	86	46	62.9	7.48	
Greenfield†	95	43	65.3	7.48	
Grinnell†	86	50	67.4	9.03	
Grundy Center	88	43	64.0	4.48	
Guthrie Center†	87	42	65.6	7.74	
Hampton	88	43	63.5	5.72	
Hawkeye				6.90	
Hopeville†	88	44	65.9	7.36	
Humboldt†	89	42	66.1	8.80	
Independence†	87	42	63.4	4.24	
Indianola†	87	34	66.4	5.49	
Iowa City†	90	44	67.8	4.10	
Iowa City b.	85	43	65.8		
Iowa Falls†	87	42	68.3	7.76	
Keosauqua†	89	48	69.2	7.92	
Knoxville	89	46	67.4	4.27	
Larrabee†	87	38	63.0	6.49	
Leclair†				4.01	
Lemars	87	42	65.0	8.64	
Lemox†	87	51	66.2	8.45	
Logan†	89	40	64.0	7.93	
Madrid	90	42	63.3	6.31	
Malvern†	92	40	65.4	7.12	
Maple Valley				8.73	
Marshall†	89	43	64.4	6.32	
Mason City†	87	40	62.4	7.31	
Maxon†	92	56	69.4	7.46	
Mechanicsville	89	44	66.0	3.98	
Millman				5.92	
Monticello††	84	43	63.3	4.54	
Moore†	91	41	67.4	3.86	
Mount Pleasant†	91	43	67.2	11.79	
Mount Pleasant†	86	35	69.6	6.55	
Mount Vernon†	91	52	66.6		
Neola	89	41	65.6	9.47	
Newton†	87	45	65.2	7.13	
North McGregor†				7.54	
Northwood	88	43	63.7	6.01	
Ogden	90	40	64.8	9.66	
Osgo†				6.67	
Oscola	93	40	66.4	6.64	
Oskaloosa†	90	43	65.8	5.51	
Ottumwa	89	47	68.3	7.52	
Ovid†	87	44	66.0	7.59	
Panama†	86	43	64.6	8.06	
Portsmouth	89	40	66.2	8.83	
Primghar	86	40	63.2	5.09	
Reinbeck				6.70	
Rock Rapids	88	34	58.5	4.11	
Sac City†	87	42	64.6	6.75	
Seymour†	90	43	67.4	7.27	
Sibley	88	38	61.8	5.42	
Sidney	87	49	66.8	7.68	
Sigourney	91	48	68.4	4.39	
Spencer	87	39	63.1	5.63	
Spirit Lake†	89	40	61.5	5.00	
Stuart	88	45	66.0	8.00	
Toledo	89	41	64.8	4.85	
Villisca†	85	39	64.7	6.73	
Vinton†	87	51	65.6	3.65	
Washington†	90	44	67.6	5.86	
Waterloo	91	44	65.8	6.13	
Wauke	90	45	66.6	6.12	
Waverly	88	45	66.5	6.38	
Westbend††	86	45	62.4	5.01	
Wilton Junction†	90	43	67.4	4.94	
Winterset†	89	40	65.2	8.43	
Kansas	°	°	°	Ins.	Ins.
Abilene†	94	44	70.2	5.54	
Achilles†	94	43	62.8	1.77	
Altamora††	88	54	69.6	5.47	
Assaria†	90	40	66.3	6.01	
Atchison†	89	44	68.0	8.43	

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.	
Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.	Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.	Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.
Stations.								Stations.									Stations.						
Kansas—Cont'd.																							
Augusta.....	95	44	71.6	5.31	Ins.			Frankfort.....	93	48	70.4	4.09	Ins.			Cambridge.....	90	44	69.8	4.00	Ins.		
Baker.....	89	43	68.0	9.85				Franklin*.....	92	61	73.0	6.52				Charlotte Hall.....	95	38	69.7	1.16			
Beloit.....	92	43	67.4	6.11				Georgetown.....	93	51	71.8					Cherryfields*.....	89	41	67.8	6.94			
Blaine.....	92	42	67.8	7.90				Greendale.....	91	52	71.9	3.10				Chestertown.....	89	41	66.6	3.98			
Burlington.....	90	44	70.2	6.59				Greensburg*.....	91	54	72.0	4.30				Collegepark.....	93	36	66.2	2.54			
Campbell.....	91	42	67.2	9.21				Harrods Creek.....	94	49	69.5	4.43				Cumberland a.....	89	46	66.5	5.09			
Chanute.....	87	47	70.2	4.70				Henderson.....	96	54	73.5	6.19				Cumberland b.....	94	51	71.2	5.17			
Colby.....	98	33	63.0	2.13				Leitchfield.....	92	47	70.2	6.41				Darlington.....	92	42	66.8	2.53			
Coldwater.....	102	40	70.2	1.41				Louisville.....	93	48	70.8	3.51				Deerpark.....	85	33	61.3	5.65			
Collyer*.....	98	48	65.5	3.00				Marion.....	93	49	70.9	4.44				Denton.....	93	45	70.4	2.77			
Columbus.....	92	44	71.0	11.41				Maysville*.....	90	60	73.2					Easton.....	91	38	67.1	3.55			
Coolidge.....	101	35	66.3	1.00				Middlesboro.....	96	46	70.6	3.00				Ellicott City.....	88	48	68.4	1.77			
Cunningham.....	104	39	72.6	1.27				Mount Sterling.....	92	49	69.6	2.41				Fallston.....	91	42	65.2	3.30			
Downs.....	92	48	65.1	2.00				Owenton.....	93	54	71.4	5.48				Flintstone.....	92	38	66.4	3.10			
Dresden*.....	92	48	65.1	2.00				Paducah.....				8.49				Frederick.....	94	42	66.6	1.40			
Effingham.....	92	41	69.6					Paducah b.....	96	54	74.9	8.79				Frederick b.....	93	50	66.0				
Eldorado.....	93	45	72.6	5.10				Pleasure Ridge Park.....	94	47	70.2	4.75				Grantsville.....	86	38	62.0	4.07			
Elgin.....	94	54	71.2	5.08				Princeton.....	96	48	72.6	11.10				Greatfalls.....	91	50	68.9	4.12			
Ellinwood.....	102	42	66.6	2.52				Pryorsburg.....	104	50	76.6	8.21				Greenspring Furnace.....	94	42	67.2	1.64			
Emporia.....	90	48	70.4	6.20				Richmond.....				1.65				Hagerstown.....	93	45	68.8	0.87			
Englewood.....	106	31	68.5	1.59				Russellville.....	92	51	72.9	7.30				Jewell.....	93	45	68.3	4.86			
Eureka.....	97	35	66.8	2.41				St. John.....	90	48	69.9	5.04				Johns Hopkins Hospital.....	96	43	68.4				
Eureka Ranch.....	97	35	66.8	2.41				Sandyhook.....				2.16				Laurel.....	94	38	67.9	3.30			
Fort Riley.....	90	45	69.2	7.11				Shelby City*.....	93	53	71.8	3.77				McDonogh.....	90	42	67.2				
Fort Scott.....	95	43	70.1	10.38				Shelbyville.....	98	48	73.1	5.60				Mardela Springs.....	92	38	67.2	3.81			
Frankfort.....	95	43	70.1	10.38				Southfork*.....				3.17				New Market.....	93	43	67.6	1.27			
Garden City.....	100	38	66.6	1.95				Springfield.....	91	49	69.2	4.92				Pocomoke City.....	93	47	70.2	2.59			
Garfield.....	92	38	64.1	1.57				Vanceburg.....	92	49	70.6	2.41				Princess Anne.....	92	31	66.3	2.17			
Gibson.....	92	38	64.1	1.57				Williamsburg.....	99	49	71.4	4.48				Sharpsburg.....	92	43	66.6	1.91			
Gove*.....	91	45	65.7	2.80				Louisiana.						Massachusetts.									
Grainfield.....	88	42	66.3	2.92				Abbeville.....	92	62	76.8	2.65				Adams.....	88	36	62.1				
Grenola.....	92	46	67.3	1.75				Alexandria.....	98	60	77.4	2.21				Amherst.....	90	33	60.2	2.46			
Halstead.....	90	42	68.3	2.40				Amite.....	98	58	77.5	2.43				Amherst Ex. Station.....	94	32	61.0	2.58			
Hays.....	95	40	68.2	3.01				Bastrop.....	96	59	76.0	2.12				Andover.....	91	31	57.5	2.46			
Horton.....	89	43	68.0	10.51				Baton Rouge.....	96	60	78.0	1.18				Ashland.....				2.32			
Hutchinson.....	100	48	71.2	2.06				Calhoun.....	99	57	77.2	1.53				Attleboro.....	92	32	59.0	2.74			
Independence.....	94	49	73.4	7.30				Cameron.....	97	63	81.8	1.01				Bedford.....	92	32	59.0	2.23			
Jacua.....	98	30	67.4	1.15				Cheneyville.....	97	58	77.7	2.10				Beverly Farms.....	92	35	58.3	2.12			
Lawrence.....	90	44	68.4	7.12				Clinton.....	100	62	80.2	1.71				Bluehill (summit).....	93	37	58.3	2.75			
Lebo.....	92	43	71.0	7.11				Covington.....	95	58	76.7	1.92				Bluehill (valley).....	94	38	57.9	2.87			
Lyons.....	103	45	72.4	6.58				Davis.....	96	54	75.2	1.85				Boston.....				1.42			
Macksville.....	107	31	70.4	2.26				Donaldsonville.....	96	62	78.0	3.69				Brockton a.....	94	53	60.0	1.79			
McPherson.....	98	44	70.2	2.77				Elm Hall.....	95	55	74.4				Brockton b.....				2.21				
Manhattan b.....	93	40	69.9	7.41				Emile.....	93	60	77.6	1.01				Brockton c.....	94	34	60.6	2.04			
Manhattan c.....	97	40	72.2	7.78				Farmerville.....	94	58	78.4	2.71				Cambridge a.....	89	26	60.4	2.42			
Marion.....	95	42	72.0	5.30				Franklin.....	96	59	78.4	3.75				Cambridge b.....	94	36	60.4	2.42			
Meadow.....	106	44	73.4	1.10				Grand Coteau.....	93	65	76.0	3.55				Chestnut Hill.....	92	31	61.2	1.85			
Medicine Lodge.....	103	41	74.6	3.98				Hammond.....	97	56	77.2	2.16				Clinton.....				1.55			
Minneapolis.....	98	42	69.7	5.97				Jeanerette.....	97	61	78.8	2.95				Cohasset.....				2.77			
Morantown.....	88	46	70.2	4.89				Lafayette.....	98	60	78.4	3.33				Concord.....	92	30	58.8	2.26			
Morton.....	105	41	70.6	0.70				Lake Charles.....	96	62	78.0	2.10				Dudley.....	90	34	60.5	1.80			
Mounthope*.....	98	51	72.0	2.30				Lake Providence.....	97	62	79.6	1.31				East Templeton*.....	89	39	60.0	1.68			
Ness City.....	99	40	69.7	1.65				Lawrence.....	97	56	78.3	0.75				Egg Rock, Nahant.....	88	37	56.4				
New England Ranch.....	94	35	65.0	3.81				Liberty Hill.....	101	56	77.4	1.75				Fallriver.....	94	35	62.1	2.87			
Norton.....	93	35	63.4	2.92				Maurepas.....	100	56	78.4	0.96				Fiskdale.....				2.08			
Norwich.....				2.48				Melville.....	95	59	77.5	4.52				Fitchburg a.....	90	40	60.2	1.90			
Oberlin.....				4.47				Minden.....	99	53	76.7	4.22				Fitchburg b.....	93	35	60.2	1.92			
Olathe.....	91	43	69.7	7.34				Monroe.....	96	60	78.3	1.21				Framingham.....	94	32	62.1	2.83			
Oswego.....	92	47	73.0	7.00				New Iberia.....	95	62	78.4	1.05				Groton.....	91	31	58.7	2.15			
Ottawa.....	92	41	69.0	6.66				Oakridge.....	99	57	78.0	1.16				Hadley.....	92	30	60.1	2.53			
Paola.....	89	43	69.2	9.20				Oberlin.....	97	59	77.5	2.40				Hingham.....				3.48			
Phillipsburg.....	98	40	68.6	3.90				Opelousas.....	98	60	77.3	3.90				Hobbs Brook.....				2.09			
Pleasant Dale.....	95	40	68.9	3.34				Oxford.....	94	56	75.0	2.47				Hyannis*.....	88	38	60				

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Massachusetts—Cont'd.						Michigan—Cont'd.						Mississippi—Cont'd.					
Plymouth*.....	98	43	60.2	2.93		Saranac.....	89	36	64.0	1.99		Fulton.....	96	50	77.0	2.15	
Princeton.....	90	33	56.7	2.37		Somerset.....	86	40	64.4	2.26		Greenville.....	94	60	77.7	0.92	
Provincetown.....	90	33	56.7	2.37		South Haven.....	85	43	63.9	1.39		Greenville*.....	96	52	77.0	1.09	
Quinapoxet.....	90	34	62.0	2.81		Stanton.....	88	38	64.1	2.27		Hazlehurst.....	97	60	78.1	0.92	
Roxbury.....	93	36	59.3	1.89		Thornville.....	90	40	66.4	2.63		Hernando.....	95	59	75.8	0.39	
Salem.....	93	36	59.3	1.89		Three Rivers.....	97	40	68.5	2.45		Holly Springs.....	96	59	75.9	4.06	
Salisbury.....	97	38	62.2	2.44		Thunder Bay Island*.....	78	42	57.5			Jackson.....	99	60	78.2	2.46	
Somerset*.....	97	38	62.2	2.44		Two Heart River*.....	84	42	56.8			Lake.....	93	59	75.6	4.25	
South Clinton.....	93	32	61.4	2.45		Vandalla.....	85	46	65.7	3.12		Leaf.....	96	60	72.8		
Springfield Armory.....	93	32	61.4	2.57		Ypsilanti.....	87	37	62.6	3.95		Leakesville.....	96	59	76.6	8.16	
Sterling.....	94	30	59.9	3.21		Minnesota.						93	63	77.2	5.16		
Taunton.....	92	35	57.1	3.22		Adair.....	89	35	61.6	5.62		Louisville.....	100	60	79.6	2.29	
Taunton*.....	92	35	57.1	3.22		Albert Lea.....	88	41	62.0	6.67		Macon.....	101	58	79.1	0.45	
Turners Falls.....	90	36	60.9	2.16		Alexandria.....	88	41	62.0	6.67		Magnolia.....	92	60	78.0	5.40	
Wakefield.....	94	33	59.7	2.54		Beardsley.....	88	33	59.4	5.62		Mosspoint.....	94	58	77.6	1.50	
Waltham.....	94	33	59.7	2.54		Belleplaine.....	92	48	65.0	3.17		Natchez.....	100	58	77.9	3.32	
Webster.....	93	30	62.0	2.50		Berndt.....	90	30	58.4			Okolona.....	95	60	76.9	4.92	
Westboro.....	93	30	62.0	2.50		Bird Island.....	89	40	61.9	4.58		Palo Alto.....	93	58	76.7	2.02	
Williamstown*.....	85	47	59.3	2.22		Bloomington.....	88	39	61.9	5.20		Poplarville.....	100	57	77.6	1.17	
Winchendon.....	90	35	59.7	2.40		Bonniwell.....	89	39	62.8	3.96		Port Gibson.....	96	57	77.6	1.54	
Winchester.....	90	35	59.7	2.40		Breese.....	87	36	57.4	7.74		Rosedale.....	95	56	77.6	1.05	
Worcester.....	89	38	61.8	2.78		Caledonia.....	87	43	63.7	4.41		Stonington.....	96	64	79.2	4.39	
Worcester*.....	89	38	61.8	2.78		Cambridge.....	88	35	61.2	3.82		Thornston.....	96	64	78.6	3.85	
Michigan.						Camden.....	88	34	62.2	4.00		Topton.....	94	66	78.8	3.85	
Adrian.....	92	41	65.9	3.79		Collegeville.....	87	42	62.8	3.15		University.....	92	53	75.2	2.00	
Allegan.....	90	39	66.2	3.40		Crookston.....	88	40	59.8	8.13		Vaiden.....	101	55	78.6	2.42	
Alma.....	89	38	63.6	2.04		Dawson.....	91	36	62.7	5.72		Water Valley*.....	96	60	74.8	1.72	
Ann Arbor.....	86	44	63.1	2.14		Faribault.....	87	40	63.8	5.51		Waynesboro.....	100	60	78.0	4.89	
Arbela.....	89	38	63.5	1.21		Farmington.....	89	37	61.8	4.97		Williamsburg.....	110	46	77.4	6.24	
Ball Mountain.....	88	42	63.4	3.89		Fergus Falls.....	87	36	59.8	6.87		Windham.....	97	59	76.6	4.66	
Baraga.....	95	26	59.1	3.51		Glencoe.....	88	38	63.4	3.09		Woodville.....	94	60	77.3	1.92	
Battlecreek.....	90	41	66.6	2.40		Greenwood.....	91	36	61.7	5.41		Yazoo City.....	103	58	79.6	1.96	
Bay City.....	89	38	63.6	4.40		Grand Meadow.....	89	40	62.0	5.32		Missouri.					
Bay City*.....	91	39	63.9	3.52		Grand Portage.....	70	28	44.4	5.21		Akron.....	89	41	69.1	9.93	
Benton Harbor.....	88	43	65.4	8.10		Granite Falls.....	90	35	60.9	3.83		Appleton City.....	89	41	69.1	13.12	
Benzonia.....	85	35	61.4	5.27		Hutchinson.....	90	38	61.2	3.35		Arlington.....	89	41	69.1	11.28	
Berlin.....	92	38	64.5	3.14		Lake Winnibigoshish*.....	87	41	56.8	8.19		Arthur*.....	82	59.4	14.86		
Berrien Springs.....	91	43	65.7	3.85		Lambert.....	86	34	59.2	10.60		Bagnell.....	88	44	68.0	8.78	
Big Rapids.....	86	37	62.8	2.59		Lawrence.....	90	35	58.6	5.17		Bethany.....	88	44	68.0	9.34	
Birmingham.....	92	43	66.8	3.14		Leech Lake.....	87	33	57.2	8.96		Birchtree.....	88	47	69.0	4.08	
Boon.....	88	33	61.4	3.42		Lesueur.....	92	36	63.4			Boonville.....	89	47	69.0	7.96	
Bronson.....	94	42	67.6	2.17		Long Prairie.....	90	33	60.5	4.87		Branswick.....	89	37	69.4	11.52	
Calumet.....	89	36	53.5	6.35		Luverne.....	85	32	61.1	3.93		Carrollton.....	88	48	70.4	7.16	
Charlevoix.....	90	39	61.4	5.50		Mapleplain.....	90	38	62.2	3.95		Cedarap.....	90	52	69.7	9.37	
Cheboygan.....	87	28	55.9	6.25		Maplewood.....	86	50	63.7			Conception.....	84	50	66.7	13.39	
Clinton.....	91	41	66.0	3.86		Mazeppa.....	92	38	68.0	3.10		Cowdell.....	88	50	69.8	9.11	
Fitchburg.....	92	40	65.3	2.39		Milan.....	88	35	60.7	3.50		Darksville.....	90	48	70.1	8.03	
Flint.....	89	35	64.4	2.28		Minneapolis.....	90	39	63.4	3.92		Downing.....	89	45	65.4	7.54	
Gaylord.....	87	30	58.9	2.89		Minneapolis*.....	89	37	63.2	3.91		East Lynne.....	85	45	65.4	9.75	
Grand Rapids.....	89	41	65.2	1.90		Minnesota City*.....	90	45	63.8	4.97		Edgehill.....	86	56	70.8	10.22	
Grape.....	87	43	66.2	4.20		Montevideo.....	89	38	61.8	4.35		Eightmile.....	84	46	67.2	9.24	
Grayling.....	96	31	62.3	2.15		Morris.....	88	37	60.9	4.64		Eldon.....	88	50	70.2	9.29	
Hanover.....	87	41	63.8	3.19		Mount Iron.....	87	31	55.9	6.81		Elmira.....	92	43	69.6	4.97	
Harrison.....	89	32	61.6	2.93		New London.....	88	38	61.0	3.46		Emma.....	90	74.0	6.40		
Harrisville.....	92	34	57.0	3.25		New Richmond.....	86	46	62.4			Fairport.....	89	47	69.0	12.42	
Hart.....	98	35	64.7	3.30		New Ulm.....	90	41	63.3	6.56		Farmersville.....	89	47	69.0	8.13	
Hastings.....	86	41	64.8	2.65		Park Rapids.....	73	32	53.6	5.70		Fayette.....	93	49	71.4	8.34	
Hayes.....	88	32	61.7	2.14		Pine River.....	89	43	53.6	5.72		Fulton.....	89	48	68.8	10.25	
Hesperia.....	90	38	63.8	2.31		Pleasant Mounds.....	89	40	61.9	6.60		Gallatin.....	89	48	68.8	10.25	
Highland Station.....	88	41	64.6	2.86		Pokegama Falls.....	89	49	56.0	7.25		Gayoso.....	94	51	71.1	4.16	
Holland*.....	85	48	63.6			Redwing.....	89	49	56.0	7.25		Gordonville.....	91	51	69.1	7.70	
Howell.....	90	36	64.5	2.98		Reeds.....	85	39	61.4	3.30		Grovedale.....	94	40	70.0	11.53	
Iron River.....	90	37	57.2	2.53		Rolling Green.....	85	39	61.4	3.30		Halfway.....	88	49	70.2	12.88	
Ivan.....	88	35	61.8	6.46		Roseau.....	87	39	64.0	4.10		Harrisonville.....	88	46	69.2	7.67	
Jeddo.....	87	38	61.9	1.44		St. Charles.....	85	40	60.4	2.57		Hastain.....	91	42	70.8	10.97	
Lansing.....	87	39	64.0	2.67		St. Cloud.....	87	38	60.2	7.02		Hermann.....	89	44	70.5	9.45	
Lathrop.....	92	35	56.4	5.14		St. Olaf.....	85	39	57.0	6.36		Houston.....	91	44	70.5	6.70	
Lewiston.....	90	34	61.2	3.78		Sandy Lake Dam.....	89	39	59.4	5.09		Houstonia (near).....	89	47	70.6	6.83	
Ludington.....	85	38	65.6			Sank Center.....	87	39	59.4	5.09		Irena.....	87	55	69.0	9.59	
Madison.....	93	43	66.7	3.39		Shakopee.....	86	43	64.4	2.63		Jefferson City.....	92	50	72.8	8.15	
Manistique.....	72	32	51.6	4.88		Tower.....	90	32	58.6	5.80		Kidder.....	90	42	68.0	9.29	
Mayville																	

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.	
Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.	Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.	Maximum.		Minimum.		Mean.		Rain and melted snow.	Total depth of snow.
Missouri—Cont'd.																							
New Palestine *†	87	54	72.3	6.88																			
Oakfield†	91	49	72.2	9.91																			
Oakmound				4.33																			
Oakridge *†		52	70.0	7.00																			
Olden†	89	47	71.0	4.28																			
Oregon a	86	47	68.4	13.02																			
Oregon b *†	86	43	66.6	14.26																			
Osceola†				18.23																			
Oto				7.00																			
Palmyra *†	90	48	75.4	7.60																			
Phillipsburg *†	87	45	69.4	12.67																			
Pickering *†		43	65.0	10.80																			
Platte River *†	90	42	67.6	9.57																			
Poplarbluff	90	46	74.4	4.27																			
Potosi	92	41	69.3	8.15																			
Princeton *†	95	46	68.0	10.02																			
Rhineland	89	46	70.7	8.79																			
Richmond *†	89	52	70.2	4.58																			
Rolla				10.04																			
St. Charles	92	50	71.4	9.86																			
St. Joseph†				7.48																			
St. Louis	89	50	70.5	9.12																			
Sarcoixie *†		52	69.4	10.14																			
Shelbina				10.00																			
Sikeston	94	53	73.4	8.25																			
Steffenville				8.54																			
Stellada†	88	44	69.3	7.76																			
Sublett	88	45	68.2	13.15																			
Tindall†				9.91																			
Trenton	86	46	68.7	10.34																			
Unionville†	88	46	68.0	12.60																			
Versailles				9.42																			
Virgil City				12.45																			
Warrensburg *†	89	59	73.5	6.41																			
Warrenton	90	49	71.2	8.44																			
Wheatland				14.70																			
Willow Springs	87	45	68.2	6.15																			
Zeitonia *†	91	51	71.0	7.90																			
Montana.																							
Agricultural College	76	32	45.2	2.35																			
Big Timber†	80	31	51.1	3.93		T.																	
Billings†	90	30	56.4	T.																			
Boulder	80	25	45.6			T.																	
Bozeman†	80	25	47.6	5.03																			
Butte†	78	16	41.8	1.43		4.0																	
Chinook†	87	32	53.4	5.17																			
Choteau†	79	26	48.4	3.84		2.0																	
Cokedale†	78	23	45.5	3.57		5.0																	
Columbia Falls†	80	26	49.0	2.24		1.0																	
Deer Lodge†	85	32	46.2	1.62		3.2																	
Dillon†	80	19	44.2	8.05		3.0																	
Fort Custer†	79	29	53.0	3.34																			
Fort Keogh†	80	30	54.3	2.22		T.																	
Fort Logan†	78	30	44.8	1.48																			
Fort Missoula	79	24	45.8	1.73		0.6																	
Glasgow†	79	27	53.8	2.56																			
Glendive†	86	35	58.0	7.03																			
Great Falls†	83	33	49.2	3.29		T.																	
Havre				0.3																			
Hogan†	80	34	45.6	2.27		3.2																	
Kipp†	78	23	44.6	5.09		20.0																	
Lewistown†	75	25	45.9	2.63		9.0																	
Libby†	89	34	50.5	1.48																			
Livingston†	78	28	49.1	2.40		T.																	
Manhattan†				0.61																			
Martindale†	72	25	46.0	4.00		12.0																	
Marysville†	74	25	42.9	3.42		14.0																	
Miles City				3.5																			
Musselshell†	87	30	51.4																				
Poplar†	78	30	53.8	3.70																			
Radersburg†				1.55																			
St. Ignace Mission†	77	31	48.7	2.68		T.																	
St. Paul†	72	30	48.0	5.10																			
Sun River†	86	31	49.0	3.51																			
Troy†	89	29	51.9	1.77		T.																	
Utica†	77	24	46.4	3.06		6.0																	
Virginia City†	78	21	42.8	4.98		22.5																	
White Sulphur Springs†	82	30	47.4	1.66		4.0																	
Wibaux	88	30	53.6	7.32		T.																	
Yale†	76	25	46.4	2.04		1.0																	
Nebraska.																							
Agee *†	90	47	64.4	1.35																			
Albion†	88	38	66.6	4.02																			
Alliance				2.00																			
Ansel†	91	32	63.0	3.52																			
Arbaho				4.03																			
Arberville *†	89	36	63.1	7.60																			
Arcadia	86	34	64.3	4.06																			
Ashland a†	88	43	65.7	10.57																			

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.							
Maximum.		Minimum.		Mean.		Rain and melted snow.		Total depth of snow.		Maximum.		Minimum.		Mean.		Rain and melted snow.		Total depth of snow.		Maximum.		Minimum.		Mean.		Rain and melted snow.		Total depth of snow.	
Stations.						Stations.						Stations.						Stations.											
New Jersey—Cont'd.						New York—Cont'd.						North Carolina—Cont'd.																	
Friesburg	90	39	62.5	1.82		Elmira	91	43	65.2	3.14		Mount Pleasant	96	47	74.2	2.48													
Gillette	90	39	62.5	2.87		Fleming	85	40	62.6	2.42		Murphy	96	45	74.6	3.15													
Hammonton	91	34	63.6	4.15		Fort Niagara	90	37	60.0	2.36		Newbern	96	45	74.6	1.99													
Hanover	91	34	63.6	2.09		Friendship	87	36	62.0	3.09		Oakridge	96	46	72.7	3.63													
Hightstown	95	39	66.2	4.07		Fulton	92	35	59.1	2.94		Pantego	93	44	72.5	3.55													
Imlaytown	93	40	67.0	3.51		Glens Falls	92	35	59.1	1.53		Pittsboro	93	44	72.5	5.50													
Junction	95	45	69.4	3.40		Gloversville	87	35	59.4	3.19		Rockingham	99	49	76.1	3.75													
Lambertville	95	45	69.4	2.41		Hamilton	86	31	59.0	2.73		Roxboro	96	46	71.9	4.80													
Linwood	94	45	68.8	2.37		Haskinville	92	40	63.2	1.73		Salem	96	46	73.6	1.34													
Millville	97	39	67.8	3.24		Honeynead Brook	91	40	63.2	3.17		Salisbury	97	53	75.6	0.98													
Moorestown	90	39	67.4	2.77		Humphrey	85	42	62.0	3.35		Saxon	98	45	73.4	4.26													
Newark	94	43	66.5	3.29		Ithaca	86	38	62.4	2.64		Selma	97	45	74.4	3.90													
Newark	94	40	65.8	3.57		Jamestown	85	40	63.0	3.77		Settle	96	47	73.4	1.42													
New Brunswick	96	39	67.2	3.96		Kings Station	87	33	59.0	3.47		Skyuka	92	48	65.8	7.07													
New Brunswick	91	37	63.6	4.02		Lebanon Springs	87	33	59.0	1.50		Sloan	96	45	74.6	3.46													
Newton	92	40	63.8	2.81		Lockport	88	40	63.2	1.15		Soapstone Mount	95	40	70.7	5.10													
Ocean City	92	45	63.6	2.90		Lowville	83	31	59.0	2.03		Southern Pine	101	47	71.5	3.40													
Oceanic	91	41	67.1	2.48		Lyons	87	43	63.3	2.27		Southport	92	46	74.3	0.52													
Paterson	98	37	66.9	3.75		Madison Barracks	79	39	59.2	2.41		Springhope	98	50	72.3	4.65													
Plainfield	95	35	66.2	3.18		Malone	82	32	58.4	1.26		Tarboro	99	40	74.0	8.56													
Rancocas	90	52	69.4	2.57		Manhattan Beach	96	40	65.7	1.94		Waynesville	98	43	67.4	6.11													
Readington	94	29	63.6	4.08		Middletown	96	40	65.7	2.96		Weldon	97	44	73.4	7.23													
Riverville	90	35	65.5	3.83		Mount Morris	92	40	63.2	1.66		Wilkesboro	93	47	71.5	10.61													
Somerville	92	37	64.6	2.21		Newark Valley	86	31	57.6	2.42		Willeton	94	40	71.6	10.61													
South Orange	92	37	64.6	2.21		New Lisbon	86	31	57.6	2.42		North Dakota.																	
Staffordville	95	33	65.8	2.88		North Hammond	86	35	61.2	2.78		Amenia	90	35	59.8	3.56													
Toms River	91	44	68.0	4.13		Number Four	82	31	56.2	2.16		Ashley	94	34	58.0	3.34													
Trenton	97	34	67.4	2.75		Ogontsburg	80	40	59.5	2.10		Batteau	82	30	54.7	4.05													
Woodbine	94	38	66.1	3.20		Ondenta	91	39	62.6	2.25		Buxton	88	32	57.0	6.66													
New Mexico.						Oxford	88	34	60.0	3.53		Churchs Ferry	89	34	56.2	4.06													
Albert	104	37	69.9	0.23		Palermo	82	33	59.5	2.26		Coalharbor	85	33	54.8	3.67													
Albuquerque	95	36	67.2	0.07		Perry City	86	34	61.1	3.81		Dickinson	86	22	52.7	5.16													
Alma	100	26	62.6	T.		Phoenix	87	40	62.2	2.05		Falconer	94	29	56.4	2.56													
Aztec	95	26	58.7	T.		Pittsford	87	40	62.2	2.05		Fargo	85	44	58.8	4.70													
Bernalillo	98	28	61.4	T.		Plattsburg Barracks	92	35	58.4	1.85		Forman	91	30	59.8	2.72													
Chama	89	13	50.7	0.05	0.5	Port Jervis	92	37	64.0	2.88		Fort Berthold	88	37	60.0	7.71													
Clayton	99	37	66.0	0.12		Potsdam	83	36	58.2	1.46		Fort Yates	92	34	58.6	1.98													
Deming	103	55	75.7	0.00		Poughkeepsie	95	35	62.6	2.50		Gallatin	90	32	56.8	5.43													
East Las Vegas	90	30	59.6	0.11		Ridgeway	92	35	62.6	2.51		Glenullin	92	28	55.6	3.13													
Eddy	105	43	74.1	0.00		Rome	84	38	60.4	2.85		Grafton	86	35	56.2	6.72													
Engle	101	34	68.8	0.02		Romulus	88	40	63.4	4.50		Grand Rapids	90	32	57.4	4.01													
Espanola	95	26	60.2	0.04		Rose	89	32	58.5	1.98		Jamestown	84	40	58.6	2.58													
Fort Bayard	95	34	63.2	0.10		Saranac Lake	89	32	58.5	1.98		Kelso	80	37	60.8	6.35													
Fort Wingate	94	28	58.4	T.		Scottsville	89	35	61.5	3.10		Lakota	84	35	56.1	4.90													
Gallisteo	93	32	63.2	T.		Setauket	89	35	61.5	3.10		Larimore	103	33	59.6	4.95													
Gallinas Spring	100	33	70.4	0.02		Sherwood	87	34	61.3	4.06		McKinney	83	32	55.8	4.45													
Gila	104	34	67.2	0.17		Skaneateles	87	34	61.3	4.06		Mayville	88	39	60.5	8.61													
Hillsboro	104	34	69.2	T.		South Canisteo	87	34	61.3	4.06		Medora	85	29	56.9	5.17													
Labellet	82	17	47.5	0.60	5.0	Southeast Reservoir	87	34	61.3	4.06		Milton	82	30	54.4	8.55													
Las Cruces	101	31	67.1	0.10		South Kortright	86	32	58.4	2.94		Minto	91	31	57.7	6.30													
Lordsburg	98	39	71.5	0.20		Turin	83	33	57.6	2.96		Napoleon	85	34	56.6	2.63													
Los Lunas	98	29	62.9	0.00		Tyrone	90	29	62.0	3.27		New England City	82	32	55.2	6.00													
Lower Penasco	90	22	67.3	T.		Varysburg	90	29	62.0	3.27		Oakdale	77	35	63.0	6.70													
Monero	92	15	53.2	0.05		Victor	94	41	65.8	3.58		Porter	83	34	54.5	4.16													
Ocate	90	23	57.5	0.01		Wappingers Falls	94	41	65.8	3.58		Power	80	35	58.8	3.23													

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
<i>Ohio—Cont'd.</i>						<i>Ohio—Cont'd.</i>						<i>Pennsylvania.</i>					
Circleville <i>b</i>	93	48	69.6	2.06		Walnut	94	49	71.2	2.22		Altoona	98	47	68.6	2.70	
Clarksville	90	50	69.2	2.39		Warren	89	43	65.6	1.79		Altoona	98	47	68.6	2.70	
Cleveland (V. O.)	94	45	65.8	1.91		Warsaw	95	41	66.5	1.88		Beaver Dam	95	43	66.5	2.39	
Clifton	95	46	68.7	3.77		Wauseon	92	43	66.4	3.44		Bethlehem	95	43	66.4	6.30	
Coalton	94	40	67.4	3.72		Waverly	98	45	71.0	2.66		Bloomington	89	31	61.2	2.98	
Colebrook	85	45	68.0	2.44		Waynesville	96	50	71.5	2.64		Brookville	95	43	66.4	1.51	
Dayton <i>a</i>	94	50	71.2	3.34		Westerville	89	46	67.4	3.12		Brown's Lock	95	43	66.4	3.37	
Dayton <i>b</i> †	94	50	71.2	3.34		Wooster	86	44	64.5	3.41		Cameron	95	43	66.4	3.56	
Defiance	94	43	69.0	2.11		Wooster <i>b</i> †	86	44	64.5	3.41		Canonsburg	88	52	70.0	1.19	
Demos	85	51	68.0	2.12		Youngstown	86	45	67.4	1.88		Carlisle	96	42	66.4	2.92	
Dupont	89	46	66.8	3.50								Cassandra	90	45	67.3	2.33	
Elyria	91	42	65.9	1.21								Cedarrun	90	45	67.3	1.90	
Fairport Harbor <i>a</i> †	83	52	64.6	.....								Centerhall†	93	44	66.0	2.00	
Fayetteville	92	50	69.6	2.82		<i>Oklahoma.</i>						Chambersburg†	93	40	65.4	3.05	
Findlay	95	46	69.4	1.65		Alva†	105	42	74.4	0.80		Coatesville	94	38	66.2	2.62	
Frankfort	90	44	68.4	3.36		Anadarko†	104	45	78.6	2.30		Confidence†	90	45	65.5	4.03	
Garrettsville†	88	41	63.9	1.94		Arapaho†	108	45	76.2	1.60		Coopersburg	90	45	65.5	4.15	
Granville	91	45	67.6	2.73		Beaver†	107	42	73.0	0.78		Davis Island Dam†	90	45	65.5	2.75	
Gratiot	90	46	67.9	2.01		Burnett†	94	39	73.6	10.21		Doylestown	90	45	65.5	2.67	
Greenfield <i>a</i>	91	51	70.2	2.85		Clifton†	96	40	74.2	2.01		Driftwood	90	45	65.5	2.96	
Greenhill	91	39	65.4	2.39		Edmond	100	43	75.2	3.92		Dubois†	90	45	65.5	1.86	
Greenville	86	48	67.2	3.61		Enid†	100	43	75.2	3.92		Duncannon	90	45	65.5	3.95	
Hackney	89	46	66.2	3.14		Fort Reno†	99	45	74.1	1.50		Dyberry†	90	35	59.8	3.58	
Hanging Rock	96	45	69.2	2.51		Fort Sill	102	47	75.9	1.26		East Bloomsburg	94	35	64.0	3.43	
Hedges	91	42	66.4	1.24		Guthrie†	97	47	74.7	6.00		East Mauch Chunk	94	35	64.0	3.24	
Hillhouse	86	38	64.0	1.34		Hennessy†	104	47	77.2	1.74		Easton	90	44	66.0	4.41	
Hillsboro†	97	43	68.6	2.22		Keokuk Falls†	98	48	70.5	5.50		Edinboro <i>a</i> †	82	42	62.2	.....
Hiram	86	44	65.5	2.18		Mangum†	104	48	77.0	1.76		Ellwood Junction†	89	39	63.8	2.	

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.		Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Rhode Island—Cont'd.						Tennessee—Cont'd.						Texas—Cont'd.					
Pawtucket.....	80	39	61.7	3.33		Bristol.....	89	45	70.0	3.00		Hewitt.....	94	63	78.6	1.70	
Providence.....	94	39	65.0	3.13		Brownsville.....	96	53	76.4	0.80		Houston.....	94	62	78.4	1.87	
Providence.....	92	36	60.4	3.50		Byrdstown.....	91	51	71.8	6.95		Huntsville.....	94	62	78.4	2.35	
South Carolina.																	
Allendale.....	96	42	77.2	1.50		Carthage.....				3.89		Kent.....				0.00	
Anderson.....				1.67		Charlotte.....				4.24		Kerrville.....	97	47	74.4	0.39	
Batesburg.....	98	51	75.6	2.96		Clarksburg.....	88	52	71.6	4.41		Lampasas.....	100	51	77.1	0.60	
Blackville.....	100	52	75.4	1.51		Clinton.....				1.79		Leakey.....	98	53	77.4	0.61	
Camden.....				3.06		Cookeville.....	94	55	75.2	3.86		Llano.....	105	65	82.2	0.50	
Central.....	95	52	75.8	5.12		Covington.....	95	52	76.4	3.19		Longview.....	100	52	79.2	2.42	
Cheraw.....	100	49	77.2	4.29		Decatur.....	93	50	72.8	3.93		Lufkin.....	99	62	80.2	T.	
Cheraw.....				4.90		Dyersburg.....	93	57	75.4	4.92		Luling.....	98	62	80.4	0.60	
Clemson College.....	98	54	76.4	4.67		Elizabethton.....	94	48	72.3	3.34		Menardville.....	104	60	77.8	0.96	
Conway.....				3.34		Elk Valley.....	87	51	69.4	4.26		Midland.....	110	51	78.4	1.04	
Darlington.....	97	54	79.0			Fairmount.....	83	38	69.5	3.92		Mount Blanco.....	103	40	75.6	0.04	
Darlington (near).....				2.64		Florence.....	88	54	72.3	3.75		New Braunfels.....	96	62	78.6	0.64	
Edisto.....				1.04		Franklin.....	91	48	71.4	3.73		Orange.....	94	62	77.6	0.02	
Edinburgh.....				3.85		Greenville.....	91	48	70.6	3.80		Panther.....				1.24	
Florence.....	96	50	77.4	4.31		Harriman.....	93	48	72.4	2.91		Paris.....	96	52	75.8	1.46	
Georgetown.....	95	42	77.3	1.62		Hohenwald.....	90	58	69.1	4.78		Point Isabel.....	88	74	82.8	T.	
Gillisonville.....	104	47	78.3	1.73		Jackson.....	91	36	74.4	4.36		Rheinland.....	110	46	80.2	0.29	
Greenville.....	90	53	71.9	5.07		Johnsonville.....	98	49	73.5	4.66		Roby.....	109	51	76.5	0.48	
Greenwood.....	100	50	76.2	1.94		Jonesboro.....	90	49	72.2	3.07		Rockport.....	90	68	79.8		
Holland.....	96	54	75.6	2.70		Liberty.....	90	52	72.6	2.66		Rocksprings.....	102			T.	
Kingstree.....	100	50	77.7	2.40		Loudon.....				2.15		Round Rock.....				1.25	
Kingstree.....				2.19		Lynnville.....	93	54	72.4	2.46		Runge.....	98	63	80.2	1.07	
Little Mountain.....	99	52	77.8	1.60		McKenzie.....	89	58	74.4	5.89		San Antonio.....	97	62	79.6	3.33	
Longshore.....	94	52	75.6	3.43		McMinnville.....	90	51	73.0	5.24		San Marcos.....				0.51	
Mount Carmel.....				2.55		Milant.....	93	52	75.5	5.60		San Marcos.....	97	60	79.3	0.31	
Pinopolis.....	98	52	74.0	6.07		Molino.....	91	55	73.4	3.94		Sierra Blanca.....	102	55	76.8	0.10	
Port Royal.....	97	54	78.5	2.61		Newport.....	93	53	71.1	3.50		Stafford.....	100	62	79.6	0.97	
St. George.....	96	50	76.6	2.19		Nunnally.....	90	56	73.5	3.77		Temble.....	99	61	79.0	1.10	
St. Matthews.....	98	52	77.4	2.30		Palmetto.....	90	54	73.7	1.57		Temple.....	96	59	77.4	1.31	
St. Stephens.....				3.22		Pope.....	90	59	74.5	3.70		Tywhig.....	105	61	82.8	1.62	
Santuck.....	95	50	75.5	2.31		Riddletown.....	90	50	72.6	6.44		Tyler.....	100	52	78.2	2.62	
Shaws Fork.....	102	59	78.4	1.58		Rockwood.....				2.66		Victoria.....				2.37	
Smiths Mills.....				2.66		Rogersville.....	89	49	70.0	3.41		Waco.....	98	52	79.7	2.55	
Society Hill.....	93	49	75.3	3.88		Rugby.....	87	53	69.6	3.22		Waxahachie.....				3.50	
Spartanburg.....	99	52	77.4	1.94		St. Joseph.....	94	49	73.0	1.37		Weatherford.....	99	54	77.4	0.60	
Statesburg.....	95	51	76.7	2.64		Savannah.....	92	60	77.1	3.07		Utah.					
Trenton.....	94	56	77.8	1.82		Sewanee.....	83	53	69.2	5.50		Alpine City.....				3.04	
Trial.....	96	50	75.6	2.74		Springdale.....	95	50	71.3	4.19		Blue Creek.....	75	30	50.3	0.40	
Winnboro.....	97	51	77.0	1.77		Tellico Plains.....				2.64		Brigham City.....				3.60	
Yemassee.....	99	50	77.8	2.37		Trenton.....	90	51	73.2	5.96		Cisco.....	100	38	62.7	T.	
Yorkville.....	96	52	76.6	1.82		Tullahoma.....	88	47	70.4	2.45		Corinne.....	87	38	60.9	1.81	
South Dakota.						Texas.											
Aberdeen.....	90	34	56.6	3.76		Union City.....	92	51	73.6	6.85		Fillmore.....	94	25	54.8	1.06	
Alexandria.....	80	36	61.2	2.06		Waynesboro.....	95	52	70.2	2.70		Fort Duchesne.....	88	23	53.4	1.40	
Armour.....	80	37	63.2	1.17		Albany.....	91	50	74.4	0.74		Giles.....	100	26	62.4	0.30	
Ashcroft.....	92	35	65.3	1.91		Arthur City.....				3.12		Grover.....	87	14	55.5	0.72	
Brookings.....	84	36	60.0	3.45		Aurora.....	102	55	78.0	3.06		Heber.....	91	20	48.9	1.85	
Canton.....	89	37	59.8	3.18		Austin.....	95	58	76.2			Huntsville.....				2.86	
Castlewood.....				4.89		Ballinger.....	105	51	77.0	0.11		Kelton.....	90	36	61.3	0.99	
Clark.....	86	38	59.4	5.11		Beeville.....	101	65	81.5	2.30		Koosharem.....	85	17	48.1	0.39	
Cross.....	84	32	52.9	1.16		Blanco.....	97			T.		Levan.....	90	23	51.8	1.58	
Edgemont.....				0.08		Boerne.....	96	62	77.1	0.98		Loa.....	92	14	48.4	0.10	
Faulkton.....	90	35	60.7	2.20		Brady.....	103	49	77.8	0.36		Logan.....	80	24	47.9	3.17	
Flandreau.....	94	36	61.8	2.06		Brazoria.....	98	65	78.1	1.44		Mammoth.....	86	34	49.2	1.84	
Forestburg.....	91	37	63.2	1.40		Brenham.....	97	62	79.4	0.96		Manti.....	98	20	55.7	0.16	
Forest City.....	90	40	63.4	2.06		Brighton.....	87	68	79.2	2.00		Millville.....				3.02	
Fort Meade.....	91	36	58.8	2.69		Brownwood.....	106	58	77.9	1.03		Moab.....	96	33	64.8	0.17	
Gary.....	89	38	60.8	5.80		Burnet.....	98	64	78.2	1.29		Mount Pleasant.....	87	33	51.8	1.09	
Goudyville.....	90	40	59.5	1.36		Camp Eagle Pass.....	108	58	82.8	2.01		Ogdens.....	80	37	54.6	3.57	
Greenwood.....	90	43	62.4	2.65		Chillicothe.....	103	40	75.2	1.75		Pahreah.....	95	38	59.0	0.30	
Highmore.....	80	38	61.8	0.95		Coleman.....				0.50		Park City.....	76	14	38.2	4.22	
Hitchcock.....				0.90		College Station.....	93	61	76.9	3.30		Parowan.....	90	25	53.5	0.93	
Hotch City.....	89	32	62.4	0.57		Colmesneil.....				3.13		Promontory.....	85	32	57.8		
Howard.....	86	34	59.0	2.46		Columbia.....	92	64	77.4	1.10		St. George.....	104	38	62.8	0.71	
Kimball.....	92	38	62.4	1.23		Corsicana.....	99	58	73.2	4.27		Salt Lake City.....				T.	
Leslie.....	97	31	63.4	0.06		Corsicana.....	98	56	75.0	3.27		Scipio.....	98	18	47.4	1.36	
Mellette.....	93	34	59.8	2.19		Cuero.....	100	64	80.6	0.73		Snowville.....	84	23	46.3	2.35	
Menno.....	92	45	64.2	2.40		Dallas.....	98	54	77.0	3.93		Soldier Summit.....	82	12	43.8	0.38	
Millbank.....	89	36	60.6	4.80		Danevang.....	98	61	78.8	1.22		Terrace.....	89	29	53.7	2.28	
Mitchell.....	89	34	62.0	1.50		Dean.....	104			2.10		Thistle.....	85	28	53.2	1.80	
Northville.....	94	32	59.8	2.00		Dublin.....	102	54									

TABLE II.—Meteorological record of voluntary and other cooperating observers—Continued.

Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.		Temperature. (Fahrenheit.)						Precipitation.		
Stations.								Stations.								Stations.								
Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.		Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.			
Virginia—Cont'd.						West Virginia.						Wisconsin—Cont'd.												
Buckingham†.....	98	36	70.2	4.96		Beverly†.....	88	44	68.4	5.50		Racine.....	90	42	62.1	3.01								
Burkes Garden.....	83	38	67.0	4.45		Bloomery†.....	88	39	62.3	2.69		Sharon†.....	89	40	64.0	3.42								
Callaville†.....	94	40	71.2	5.65		Bluefield†.....	89	44	68.8	2.18		Shawano.....	90	35	61.2	3.23								
Charlottesville.....	96	47	70.9	3.01		Buckhannon†.....	88	43	69.0	2.44		Spoonert.....	89	33	59.8	2.86								
Christiansburg†.....				3.91	T.	Buckhannon‡.....	88	43	69.0			Stevens Point†.....	90	38	63.7	7.68								
Clarksville†.....				4.46		Burlington†.....	92	40	66.0	3.28		Valley Junction†.....	91	37	63.4	4.20								
Dale Enterprise†.....	92	43	67.2	1.99		Charleston†.....				4.13		Viroqua.....	86	43	63.6	5.86								
Danville†.....				3.99		Dayton.....				4.43		Watertown†.....	87	43	65.7	5.03								
Fredericksburg†.....	95	44	69.8	4.60		Elkhorn†.....	88	46	68.8	1.61		Waukesha†.....	86	43	64.2	4.12								
Goshen*†.....	90	36	66.5			Fairmont†.....				5.92		Waupaca†.....	90	39	64.1	7.57								
Graham's Forge†.....	89	41	67.1	2.68		Glenville†.....	89	46	67.9	2.32		Wausau†.....	89	38	62.9	5.03								
Hampton.....	92	46	71.4	7.08		Grafton†.....	91	44	68.2	4.84		Westbend.....	88	42	63.5	9.35								
Hot Springs.....	88	42	66.2	3.63		Green Sulphur†.....	90	50	69.2	2.45		Westfield†.....	88	43	64.9	7.09								
Lexington†.....	93	47	70.1	1.55		Harpers Ferry†.....				4.60		Whitehall†.....	89	35	62.7	4.60								
Maldens.....	94	56	75.5			Hewett†.....	92	47	71.2	2.83		Wyoming.												
Manassas†.....	94	40	69.2	5.41		Hinton†.....				3.97		Bighorn Ranch†.....	73	18	41.8	1.21								
Marion†.....	90	45	69.1	3.20		Leachtown†.....	91	40	71.1			Cheyenne.....	73	—	39.6	1.70						T.		
Monterey†.....	88	40	64.8	4.31		Marlinton†.....	88	40	66.1	3.74		Embar†.....	73	—	39.6	1.70								
Petersburg†.....	97	40	73.9	7.25		Martinsburg†.....	93	41	66.4	1.26		Fort Laramie†.....	92	24	57.7	2.63								
Quantico*.....	93	41	67.4			Morgantown†.....				3.82		Fort Washakie.....	82	16	47.6	2.13								
Radford†.....				2.59		Morgantown‡.....	90	42	68.2	3.57		Lander (W. B.).....										0.4		
Richmond (near)†.....	98	50	72.8	4.21		New Martinsville†.....	93	47	69.2	3.06		Laramie.....	76	20	47.2	2.37								
Rockmount†.....	95	50	72.5	2.85		Nuttallburg†.....	86	42	66.3	2.30		Lusk†.....	91	23	54.4	2.78								
Rural Retreat.....	89	41	67.0	2.27		Oldfield†.....	92	42	67.4	2.55		Sheridan.....	81	21	49.4	0.81								
Salem†.....	90	52	70.2	2.01		Pennsboro.....	92	45	69.0	3.23		Sundance.....	84	28	51.8	1.94								
Saltville.....	89	44	68.4	2.16		Phillippi.....	89	50	71.0	3.63		Wheatland†.....	94	31	59.2	2.73								
Smithville†.....	98	47	71.1	7.15		Point Pleasant†.....	95	50	71.7	2.18		Mexico.												
Spottsville†.....	94	38	71.2	7.75		Powellton†.....	89	49	69.1	4.13		Ciudad P. Diaz.....	100	64	82.2	1.60								
Standardsville†.....	93	42	67.9	3.73		Rowlesburg†.....				3.21		Leon de Aldamas.....	94	53	74.1	0.28								
Staunton†.....	94	46	69.1	4.13		Sandyville†.....	92	44	68.8	2.15		Mexico.....	89	50	69.0	0.47								
Stephens City†.....	94	45	69.2	1.43		Spencer†.....	95	59	70.8	1.60		Puebla.....	87	50	69.4	3.41								
Sunbeam†.....	92	44	72.3	8.72		Tannery*†.....	83	45	68.1			Topolobampo*†.....	86	61	77.4	0.00								
Warsaw†.....	95	38	70.5	4.10		Weston†.....				3.39		New Brunswick.												
Westbrook Farm.....	96	41	71.8			Weston‡.....	91	52	70.0			St. John.....	83	28	48.2	0.90								
Wytheville†.....	87	45	66.8	2.76		Wheeling†.....				3.47		West Indies.												
Washington.						Wheeling‡.....	92	52	70.9	2.90		Grand Turk Island.....										0.29		
Aberdeen†.....	84	35	52.0	6.09		White Sulphur Springs†.....	92	38	66.4	2.13		EXPLANATION OF SIGNS.												
Anacortes.....				1.04		Wisconsin.						* Extremes of temperature from observed readings of dry thermometer.												
Ashford†.....				7.74	2.8	Amherst.....	88	37	63.8	7.65		† Weather Bureau instruments.												
Blaine†.....	74	27	50.1	2.47		Antigo†.....	90	31	60.2	5.61		‡ Record furnished by the Arrowhead Reservoir Company, in the San Bernardino Mountains, San Bernardino County, Cal., at elevations varying from 4,900 to 6,900 feet.												
Bridgeport†.....	98	15	52.1	1.25		Apollonia*†.....	90	41	65.3	5.70		A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:												
Cascade Tunnel†.....	76	20	43.9	6.10	16.0	Bayfield†.....	89	35	53.2	3.62		1 Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. + 4.												
Centerville†.....	84	34	51.2	1.08		Beloit.....	88	48	66.8	5.02		2 Mean of 8 a. m. + 8 p. m. + 2.												
Chehalis†.....	88	32	54.0	3.69		Boscobel†.....	88	45	65.0	5.54		3 Mean of 7 a. m. + 7 p. m. + 2.												
Colfax†.....	85	31	49.0	2.10	2.0	Butternut†.....	93	32	61.1	4.04		4 Mean of 6 a. m. + 6 p. m. + 2.												
Connell†.....	93	30	63.3			Centralla.....	90	41	64.0	4.63		5 Mean of 7 a. m. + 2 p. m. + 2.												
Coupeville†.....	68	35	50.9	1.78		Chilton.....	86	37	63.0	3.50		6 Mean of readings at various hours reduced to true daily mean by special tables.												
Eastsound†.....	68	38	51.8	1.72		Citypoint.....	91	36	63.4	5.29		7 Mean from hourly readings of thermograph.												
Ellensburg†.....	84	32	52.9	1.26		Crandon†.....	90	35	63.4	3.05		8 Mean of 7 a. m. + 2 p. m. + 9 p. m. + 3.												
Ellensburg (near).....	84	32	52.1	0.85	T.	Delavan†.....	86			2.44		9 Mean of sunrise and noon.												
Fort Simcoe†.....	93	24	53.4	1.14		Deperet†.....	88	39	62.8	2.69		10 Mean of sunrise, noon, sunset, and midnight.												
Fort Spokane.....	85	26	49.5	2.70		Eau Claire.....	74	36	56.7	4.50		The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.												
Grandmound†.....	82	34	51.9	3.54		Florence†.....	90	29	56.9	3.87		An italic letter following the name of a station, as "Livingston a," "Livingston b," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance, "a" denotes 14 days missing.												
Hunters†.....	77	24	44.8	3.33	4.5	Fond du Lac†.....	89	40	64.0	3.85		No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.												
Kennewick†.....	92	39	59.4	0.53		Grand River Lock.....				8.65		NOTE.—The following change has been made in name of station: Mississippi, Mico changed to Windham.												
Lakeside†.....	79	35	53.4	1.80		Grantsburg†.....	90	36	60.0	5.91		Page 5, Review for January, 1896, in the last column of the first line of the small table, the mean velocity at the cirrus level should be 48.9, instead of 43.9.												
Lapush†.....	70	36	50.0	5.19	T.	Hartford.....				5.38														
Madrone*†.....	73	36	52.4	3.82		Harvey†.....	89	44	63.8	4.49														
Mayfield†.....	84			6.60		Hayward†.....	90	32	60.3	5.10														
Montecristo†.....	59	30	40.3	5.80	30.5	Hillsboro.....	87	38	63.1	5.37														
Moxee Valley†.....	88	28	55.2	1.09		Koepentek*†.....	86	42	60.6	5.50														
New Whatcom†.....	74	35	53.4	2.47		Lancaster†.....	89	40	63.3	5.00														
Olga†.....	73	32	49.9	1.63		Lincoln†.....				6.30														
Olympia†.....	89	35	54.4	3.98		Madison†.....	83	49	63.4	6.31														
Pine Hill†.....	82	33	52.8	1.90		Manitowoc†.....	88	39	57.8	3.98														
Pomeroy†.....	88	33	53.7	0.76		Meadow Valley†.....	90	41	63.6	6.15														
Pullman†.....	84	30	47.7	2.42		Medford†.....	91	30	61.4	5.22														
Queets†.....	74	34	49.2	6.58		Menasha.....				3.16														
Rosalia†.....	81	32	47.5	2.31	5.0	Neillsville†.....	88	36	63.2	5.26														
Shoalwater Bay*†.....	65	43	50.7			New Holstein.....	88	39	63.4	5.00														
Silvercreek*†.....	82	33	48.4	5.88		New London.....	89	40	63.4	4.78														
Snohomish†.....	77	37	53.2	4.17		Oconomowoc†.....	86	43	65.4	3.65														
Southbend†.....	86	34	51.7	7.49		Oconto.....	90	37	61.0	4.16														
Spokane.....					T.	Osceola†.....	92	33	63.0	4.86														
Stampedet.....	76	27	43.0		17.0	Oshkosh†.....	87	45	64.6	4.74														
Sunnyside†.....	89	31	56.4	0.58		Peplin.....	87	37	62.8	3.49														
Tacoma†.....	77	34	51.0	3.79		Pine River†.....	90	40	64.6	9.08														
Union City†.....	81	34	52.0	4.61		Portage†.....	88	46	65.3	6.11														
Vashon†.....	72	37	51.6	3.21		Port Washington.....	88	40	59.8	6.04														
Waterville†.....	79	28	48.1	2.16	1.5	Prairie du Chien.....	93	40	63.3	6.93														
Wenatchee Lake†.....	78	30	47.5	1.75																				
West Ferndale†.....	77	35	53.4	2.80																				

TABLE III.—Data from Canadian stations for the month of May, 1896.

Stations.	Pressure.			Temperature.		Precipitation.		Prevailing direction of wind.	Total depth of snow.
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Total.	Departure from normal.		
St. John's, N. F.	Inches. 29.88	Inches. 30.08	Inches. + .08	° 59.8	° - 4.6	Inches. 3.69	Inches. - 1.27	ne.	3.5
Sydney, C. B. I.	29.96	30.02	+ .06	43.6	- 0.9	3.06	- 1.27	sw.	0.0
Grindstone, G. St. L. Sandy Point	29.91	29.94	.....	41.0	.....	0.86	.....	sw.	0.0
Halifax, N. S.	29.92	30.06	+ .06	47.5	+ 0.5	2.53	- 2.19	s.	0.0
Grand Manan, N. B.	29.96	30.01	.....	45.2	+ 0.6	1.54	- 1.99	se.	0.0
Yarmouth, N. S.	29.94	30.02	+ .04	47.6	+ 0.6	3.73	- 2.19	se.	0.0
St. Andrews, N. B.	29.96	30.00	.....	46.4	+ 3.0	1.35	- 1.90	se.	0.0
Charlottetown, P. E. I.	29.98	30.00	.....	49.0	+ 2.2	1.17	- 2.73	e.	0.0
Chatham, N. B.	29.92	29.96	+ .01	45.7	+ 3.4	3.37	+ 0.94	e.	0.0
Father Point, Que.	29.63	29.96	+ .01	52.9	+ 3.4	2.15	- 0.97	ne.	0.0
Quebec, Que.	29.75	29.95	+ .02	57.4	+ 3.4	2.74	- 0.34	sw.	0.0
Montreal, Que.	29.42	29.92	.....	55.2	+ 5.7	3.11	- 0.49	sw.	0.0
Rockliffe, Ont.	29.64	29.95	- .01	56.2	+ 3.2	2.49	- 0.26	sw.	0.0
Kingston, Ont.	29.59	29.97	- .01	58.6	+ 5.6	2.44	- 0.21	w.	0.0
Toronto, Ont.	29.54	29.87	.....	53.4	+ 9.8	3.40	+ 1.89	w.	1.9
White River, Ont.	29.35	29.98	.00	50.1	.....	4.30	+ 1.46	e.	0.0
Port Stanley, Ont. ....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE III.—Data from Canadian stations—Continued.

Stations.	Pressure.			Temperature.		Precipitation.		Prevailing direction of wind.	Total depth of snow.
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Total.	Departure from normal.		
Saugeen, Ont.	Inches. 29.34	Inches. 29.94	Inches. - .02	° 56.2	° + 6.2	Inches. 1.46	Inches. - 1.11	w.	0.0
Parry Sound, Ont.	29.34	29.92	- .04	55.2	+ 4.7	1.88	- 1.44	nw.	0.0
Port Arthur, Ont.	29.16	29.86	- .06	50.2	+ 3.7	4.10	+ 1.92	ne.	0.0
Winnipeg, Man.	28.98	29.80	- .13	54.8	+ 4.8	5.32	+ 2.50	n.	0.0
Minneapolis, Man.	28.02	29.80	- .09	52.4	+ 3.4	3.07	+ 1.43	e.	0.0
Qu'Appelle, Assin.	27.56	29.80	- .08	50.2	+ 0.2	4.73	+ 3.21	w.	0.0
Medicine Hat, Assin.	27.26	29.83	- .06	48.8	- 2.2	2.90	+ 1.41	w.	0.0
Swift Curr't, Assin.	26.29	29.84	- .04	44.6	- 6.4	1.94	+ 0.45	w.	0.9
Calgary, Alberta.	28.28	29.78	.....	49.7	.....	2.40	.....	nw.	0.0
Prince Albert, Sask.	27.50	29.83	- .09	47.8	- 1.8	1.94	+ 0.34	nw.	T.
Edmonton, Alberta.	28.06	29.78	.....	50.0	.....	3.69	.....	nw.	0.0
Battleford, Sask.	28.06	29.88	.....	55.1	.....	0.36	.....	s.	0.0
Spences Br'ge, B. C.	29.96	30.12	+ .06	68.6	.....	2.84	.....	sw.	.....
Hamilton, Bermuda	41.5	.....	.....	41.5	.....	1.04	.....	sw.	0.0
Banff, Alberta.	29.96	29.99	.....	48.3	.....	1.62	.....	sw.	0.0
Esquimaux, B. C.	29.62	29.97	.....	57.8	.....	2.26	.....	w.	.....
Sable Island. ....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV.—Meteorological observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, Meteorologist to the Government Survey.

Pressure is corrected for temperature and reduced to sea level, but the gravity correction, -0.06, is still to be applied.

The absolute humidity is expressed in grains of water, per cubic foot, and is the average of four observations daily.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 10. Two directions of wind, connected by a dash, indicate change from one to the other; also same for force.

The rainfall for twenty-four hours is given as measured at 6 a. m. on the respective dates.

April, 1896.	Pressure at sea level.				Temperature.		Absolute.	Direction.	Force.	Cloudiness.	Rain measured at 6 a. m.				
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	3 p. m.	9 p. m.									
1 ..	Ins.	Ins.	Ins.	72	77	72	78	66	73	6.1	ne.	0.15			
2 ..	30.12	30.06	30.15	71	76	71	77	66	75	6.3	ne.	0.08			
3 ..	30.16	30.08	30.11	72	75	72	76	66	72	6.1	ne.	0.18			
4 ..	30.17	30.08	30.16	70	75	72	77	69	65	5.7	ne.	0.01			
5 ..	30.14	30.07	30.14	71	74	73	77	70	67	5.8	ne.	0.01			
6 ..	30.15	30.08	30.16	71	78	71	78	70	62	6.2	ne.	0.00			
7 ..	30.14	30.06	30.13	70	78	71	79	67	65	6.2	s-ne.	0.00			
8 ..	30.13	30.04	30.13	65	77	73	81	64	68	6.7	ne.	0.00			
9 ..	30.12	30.08	30.12	68	76	74	78	67	66	7.0	ne-s-e.	0.00			
10 ..	30.11	30.02	30.10	71	79	72	80	71	70	6.9	s-ne.	0.04			
11 ..	30.08	30.00	30.08	71	78	73	79	69	66	8.4	s-ne.	0.03			
12 ..	30.08	30.01	30.09	71	79	70	80	69	77	7.3	e-s.	0.02			
13 ..	30.11	30.02	30.09	68	78	73	80	66	74	6.8	s-ne.	0.00			
14 ..	30.10	30.00	30.08	69	79	71	80	68	66	6.9	s.	0.00			
15 ..	30.08	29.95	30.01	69	80	70	81	66	70	6.7	s-e.	0.02			
16 ..	30.05	29.99	30.06	71	78	73	80	68	65	6.1	ne.	0.00			
17 ..	30.09	29.99	30.05	70	77	71	81	70	62	7.7	ne.	0.00			
18 ..	30.08	29.96	30.03	66	80	72	82	65	66	7.5	s-n.	0.00			
19 ..	30.03	29.95	30.02	67	80	73	82	66	69	8.0	se.	0.00			
20 ..	30.04	29.98	30.05	70	76	69	79	69	77	8.5	se.	0.00			
21 ..	30.10	30.05	30.14	68	72	73	78	68	74	7.2	s-ne.	0.50			
22 ..	30.16	30.06	30.12	70	78	73	80	68	74	6.3	ne.	0.21			
23 ..	30.12	30.02	30.10	71	79	73	79	70	63	7.3	ne.	0.00			
24 ..	30.10	30.04	30.12	72	78	74	80	68	67	6.6	ene.	0.00			
25 ..	30.15	30.08	30.16	72	78	71	79	72	59	7.8	ne.	0.02			
26 ..	30.14	30.06	30.14	71	79	70	80	69	63	7.4	ne.	0.01			
27 ..	30.13	30.08	30.17	71	76	70	79	69	66	7.6	n-ne.	0.08			
28 ..	30.19	30.15	30.19	70	71	70	73	69	80	8.1	e-ne.	0.23			
29 ..	30.23	30.16	30.21	69	72	70	74	66	76	8.4	6.3	1.50			
30 ..	30.14	30.06	30.15	72	76	72	79	66	65	7.3	ne.	0.75			
Mean temperature: 6+2+9+3 is 72.6; the normal is 73.0; extreme temperatures, 82° and 64°.	30.12	30.04	30.11	70.0	77.0	71.7	78.9	68.2	68.0	75.3	6.5	8-0	5-5	3.84

Meteorological observations at Honolulu, Republic of Hawaii, by Curtis J. Lyons, Meteorologist to the Government Survey.

May, 1896.	Pressure at sea level.			Temperature.					Humidity.		Wind.		Cloudiness.	Rain measured at 6 a. m.	
	9 a. m.	3 p. m.	9 p. m.	6 a. m.	3 p. m.	9 p. m.	Maximum.	Minimum.	Relative.		Absolute.	Direction.			Force.
									9 a. m.	9 p. m.					
1 ..	Ins.	Ins.	Ins.	°	°	°	°	°	°	°	°	ne.	4	3	Ins.
2 ..	30.16	30.10	30.16	72	76	73	78	71	66	82	6.4	ne.	4	3	0.00
3 ..	30.16	30.08	30.14	72	76	73	78	70	66	73	6.2	ne.	4	3	0.02
4 ..	30.15	30.07	30.16	73	76	73	78	69	70	73	6.4	ene.	6	3	0.27
5 ..	30.14	30.05	30.10	73	77	73	78	71	82	73	6.8	ene.	5	5	0.20
6 ..	30.09	30.01	30.09	71	72	71	81	70	67	81	6.8	ne.	2	5	0.30
7 ..	30.06	30.03	30.12	71	77	74	81	65	74	74	7.0	ene.	3	7	0.03
8 ..	30.15	30.09	30.16	73	78	74	80	72	63	70	6.4	ne.	4	3	0.00
9 ..	30.16	30.13	30.20	73	77	74	79	72	63	70	6.4	ne.	6	3	0.00
10 ..	30.21	30.15	30.20	71	77	73	78	68	62	69	6.2	ne.	4	4	0.08
11 ..	30.16	30.08	30.14	72	76	73	79	69	66	69	6.2	ne.	4	3	0.03
12 ..	30.07	29.97	30.05	70	72	73	80	68	70	69	6.5	ne.	3	4	0.14
13 ..	30.02	29.96	30.01	70	77	72	80	67	67	77	6.6	ne.	3	3	0.01
14 ..	30.04	29.99	30.06	72	79	71	82	67	74	86	7.4	sw.	2	4	0.01
15 ..	30.09	30.02	30.11	69	83	74	83	65	67	82	7.4	s.	3	3	0.00
16 ..	30.08	29.99	30.05	69	81	74	81	66	74	7.5		e-sw.	3	5	0.02
17 ..	30.07	30.02	30.08	68	80	75	83	66	74	7.0		e.	3	5	0.00
18 ..	30.12	30.06	30.11	74	80	75	81	72	66	70	6.6	ne.	4	2	0.00
19 ..	30.15	30.07	30.15	74	80	74	83	73	57	70	6.2	ene.	4	2-5	0.00
20 ..	30.14	30.09	30.16	74	79	75	81	73	60	62	6.4	ene.	3	2	0.00
21 ..	30.20	30.12	30.17	73	78	74	80	72	56	66	6.0	ene.	4	3-6	0.00
22 ..	30.30	30.13	30.20	73	80	74	82	72	59	66	6.2	ne.	5	3	0.00
23 ..	30.19	30.09	30.18	73	78	74	80	72	52	70	6.1	nne.	5	2-6	0.00
24 ..	30.20	30.10	30.17	73	80	74	81	72	63	70	6.1	ne.	5	4	0.00
25 ..	30.19	30.10	30.19	72	79	74	81	70	70	70	6.8	ne.	4	3-6	0.03
26 ..	30.19	30.11	30.17	73	79	74	82	73	66	74	6.7	ne.	4	3	0.00
27 ..	30.19	30.11	30.18	73	80	74	81	73	66	67	6.4	ne.	4	3	0.01
28 ..	30.17	30.11	30.19	72	80	73	82	71	59	78	6.4	ne.	4-1	3	0.00
29 ..	30.19	30.12	30.17	72	81	74	81	71	59	70	6.1	ne.	3	7	0.01
30 ..	30.17	30.10	30.15	72	79	73	82	70	59	73	6.0	ne.	4	3	0.05
31 ..	30.17	30.11	30.15	73	80	74	80	68	66	74	6.5	nne.	4	4-6	0.15
	30.18	30.12	30.18	72	77	74	78	69	66	66	6.4	ne.	5	6	0.19
	30.14	30.07	30.14	72.0	78.6	73.6	80.4	69.9	65.4	72.2	6.5		3.8	4-0	1.31

TABLE V.—Mean temperature for each hour of seventy-fifth meridian time, May, 1896.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Bismarck, N. Dak.....	51.5	50.6	50.0	48.5	47.5	47.1	47.0	49.3	51.7	55.2	57.5	60.0	62.6	64.6	65.4	66.5	66.7	66.3	65.9	64.6	61.4	57.6	55.1	53.5	56.9
Boston, Mass.....	56.0	55.4	55.0	54.5	54.0	54.5	56.2	58.6	60.4	62.0	63.0	63.1	63.8	64.1	63.5	63.7	64.0	63.8	62.0	60.6	58.5	56.6	57.8	57.1	59.6
Buffalo, N. Y.....	56.6	56.3	55.8	55.1	55.0	55.2	56.6	57.3	58.1	58.9	60.3	60.4	60.7	61.1	62.0	62.5	61.6	60.7	59.5	58.5	57.9	57.3	57.1	58.5	58.5
Chicago, Ill.....	63.0	62.8	61.4	60.8	60.2	59.7	60.2	62.1	63.7	66.4	67.8	68.7	69.3	70.6	70.9	70.5	70.3	69.7	68.8	68.1	66.8	64.9	64.1	63.6	65.6
Cincinnati, Ohio.....	68.0	67.1	66.0	65.0	64.1	63.5	63.9	63.5	68.1	71.2	73.8	75.8	77.0	77.3	77.4	77.6	77.7	77.8	76.9	76.0	73.8	72.2	70.5	69.3	71.5
Cleveland, Ohio.....	63.2	62.2	61.7	60.9	60.5	59.9	61.1	63.0	65.5	66.7	68.0	68.0	68.4	69.0	69.6	70.2	70.5	70.2	69.7	69.0	67.5	65.7	64.5	63.3	65.8
Detroit, Mich.....	60.7	59.7	59.3	58.9	58.2	58.0	59.0	61.1	64.2	66.4	68.7	70.4	71.6	72.5	73.6	74.4	75.5	76.0	75.9	74.9	73.0	70.8	69.2	68.1	69.4
Dodge City, Kans.....	63.9	63.1	62.2	61.5	60.4	59.7	58.5	59.8	62.3	65.3	68.4	71.0	73.1	75.5	77.2	78.3	78.5	78.4	77.3	74.8	71.6	68.4	66.6	65.4	68.4
Eastport, Me.....	43.4	43.0	42.5	42.3	42.6	43.9	45.8	47.9	49.4	51.5	53.2	52.5	52.9	53.0	52.1	50.8	49.5	48.3	47.0	46.0	45.6	44.5	44.0	43.7	47.3
Galveston, Tex.....	76.8	76.7	76.5	75.9	75.8	75.8	75.9	76.5	77.1	78.0	78.5	79.2	79.7	79.7	79.8	79.7	79.4	79.1	78.6	78.1	77.7	77.5	77.4	77.4	77.8
Havre, Mont.....	46.6	45.8	44.7	43.7	42.8	42.1	41.7	43.2	45.7	48.0	50.5	52.2	53.9	55.1	56.5	57.1	57.7	57.2	57.3	57.3	55.3	52.3	49.5	48.3	50.2
Kansas City, Mo.....	66.3	65.6	64.6	64.0	63.4	62.9	63.0	63.9	66.5	68.5	70.5	72.4	73.9	74.8	75.6	75.9	76.0	75.5	74.9	73.0	70.8	69.2	68.1	66.9	69.4
Key West, Fla.....	77.0	76.9	76.9	76.7	76.7	76.6	77.6	78.8	79.6	80.1	80.7	81.3	81.2	81.6	81.5	81.8	80.6	79.9	78.9	78.2	78.0	77.8	77.5	77.5	78.9
Memphis, Tenn.....	72.7	71.8	70.8	70.1	69.4	69.0	69.2	71.0	72.9	75.7	78.7	80.4	81.8	83.1	83.8	84.2	83.6	83.3	81.9	80.3	78.5	76.8	75.4	74.8	76.6
New Orleans, La.....	73.1	72.8	72.5	72.3	72.2	72.0	72.8	73.9	76.2	78.8	80.5	81.9	82.7	83.4	82.7	83.1	82.4	81.6	80.3	78.8	76.8	75.5	74.3	73.8	77.2
New York, N. Y.....	59.8	58.9	58.5	58.1	57.6	57.7	58.7	60.0	61.8	63.6	65.5	66.9	68.0	67.7	67.4	67.4	67.2	66.0	65.0	64.7	63.9	62.5	61.7	61.0	62.9
Philadelphia, Pa.....	62.7	61.7	61.0	60.5	60.7	61.7	63.7	65.4	67.7	69.7	71.1	72.4	73.5	74.8	75.6	75.9	76.0	75.5	74.9	73.0	70.8	69.2	68.1	66.9	69.4
Pittsburg, Pa.....	65.4	64.7	64.0	63.1	62.7	62.4	63.5	65.0	68.1	70.0	72.1	73.9	75.5	76.6	76.4	76.5	76.2	75.3	74.0	72.0	69.9	68.5	67.4	66.2	69.5
Portland, Oreg.....	50.3	49.8	48.8	48.4	47.6	46.8	46.2	45.9	46.5	47.5	48.9	50.4	51.9	53.4	55.1	55.4	56.3	57.1	57.2	55.9	54.6	53.0	51.9	51.5	55.8
St. Louis, Mo.....	69.9	69.1	68.3	67.5	67.0	66.6	66.5	67.6	69.3	71.4	73.7	76.1	77.7	79.2	80.1	80.8	80.5	79.6	77.9	75.9	74.6	73.1	71.7	70.5	73.1
St. Paul, Minn.....	60.2	59.2	58.3	57.8	57.0	56.3	56.3	57.7	60.4	62.8	65.4	68.3	69.1	70.2	70.3	70.3	69.6	68.9	67.5	65.6	64.2	62.7	61.6	61.6	63.6
Salt Lake City, Utah.....	50.5	49.5	48.4	47.6	47.1	46.3	45.5	45.4	46.6	48.7	51.4	53.8	54.2	55.3	56.7	57.4	57.7	57.9	58.1	58.0	57.2	56.2	55.8	55.3	58.3
San Diego, Cal.....	60.0	59.3	58.6	58.3	58.0	57.7	57.4	57.1	57.5	59.0	60.8	62.6	64.1	65.0	65.7	65.7	65.7	65.7	65.4	65.6	64.5	63.0	61.7	60.9	61.6
San Francisco, Cal.....	54.0	53.8	53.5	52.8	52.5	52.4	51.8	51.6	52.2	53.3	54.9	56.3	58.2	59.1	59.7	60.3	60.6	60.4	59.5	59.0	57.5	55.9	54.6	54.5	55.8
Savannah, Ga.....	71.3	70.9	70.4	70.0	69.6	69.7	71.7	74.5	78.5	81.0	83.2	84.1	84.7	83.7	82.6	81.4	79.8	77.8	76.0	74.8	73.7	73.1	72.5	72.1	76.1
Washington, D. C.....	63.5	62.6	61.8	61.1	60.5	60.6	62.7	64.9	67.7	69.9	72.0	73.7	74.3	75.5	76.0	75.7	75.6	74.3	72.5	69.9	68.3	66.9	65.5	64.4	68.3

TABLE VI.—Mean pressure for each hour of seventy-fifth meridian time, May, 1896.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Bismarck, N. Dak...	28.065	.065	.066	.063	.067	.073	.077	.083	.086	.087	.084	.079	.072	.064	.058	.051	.044	.041	.040	.042	.049	.061	.070	.076	.065
Boston, Mass.....	29.887	.884	.882	.884	.891	.902	.910	.905	.900	.895	.889	.883	.869	.855	.849	.844	.844	.845	.854	.863	.872	.874	.875	.876	.876
Buffalo, N. Y.....	29.155	.152	.153	.156	.162	.176	.181	.185	.188	.189	.188	.182	.174	.166	.157	.151	.147	.145	.148	.150	.155	.157	.160	.158	.164
Chicago, Ill.....	29.059	.055	.054	.061	.067	.079	.089	.094	.096	.095	.091	.087	.084	.076	.066	.058	.051	.048	.046	.050	.062	.071	.070	.069	.070
Cincinnati, Ohio.....	29.341	.338	.340	.342	.349	.364	.378	.383	.390	.387	.384	.372	.356	.348	.331	.321	.315	.313	.312	.330	.336	.342	.343	.345	.348
Cleveland, Ohio....	29.191	.188	.191	.196	.205	.217	.231	.233	.235	.231	.232	.222	.217	.210	.197	.183	.176	.175	.178	.180	.187	.193	.193	.193	.202
Detroit, Mich.....	29.194	.191	.194	.195	.200	.208	.217	.223	.225	.223	.223	.219	.210	.209	.186	.178	.174	.167	.168	.177	.190	.199	.201	.201	.199
Dodge City, Kans.....	27.257	.251	.252	.248	.250	.260	.273	.280	.288	.295	.296	.288	.274	.261	.247	.234	.226	.224	.227	.237	.246	.260	.266	.266	.260
Eastport, Me.....	29.923	.918	.915	.919	.926	.933	.940	.939	.938	.932	.924	.910	.899	.889	.884	.881	.881	.884	.892	.903	.909	.911	.912	.911	.911
Galveston, Tex.....	29.973	.970	.963	.957	.954	.960	.971	.981	.985	.989	.995	.996	.987	.978	.965	.955	.946	.942	.948	.961	.971	.977	.977	.977	.971
Havre, Mont.....	27.249	.249	.250	.246	.247	.251	.254	.257	.257	.256	.250	.243	.235	.228	.223	.218	.217	.215	.216	.223	.234	.246	.249	.249	.240
Kansas City, Mo.....	28.904	.897	.893	.891	.896	.904	.919	.925	.931	.932	.926	.922	.913	.904	.893	.881	.868	.865	.869	.877	.886	.900	.913	.912	.901
Key West, Fla.....	30.046	.045	.045	.043	.045	.045	.050	.061	.067	.070	.070	.065	.053	.041	.028	.017	.014	.015	.022	.034	.045	.056	.060	.056	.042
Memphis, Tenn.....	29.576	.568	.566	.567	.570	.584	.595	.603	.614	.617	.615	.609	.598	.589	.575	.558	.548	.544	.544	.551	.556	.569	.574	.574	.578
New Orleans, La.....	29.994	.988	.985	.983	.988	.998	.005	.007	.019	.022	.023	.017	.007	.008	.006	.006	.006	.007	.007	.007	.008	.009	.009	.009	.004
New York, N. Y.....	29.705	.701	.695	.694	.695	.704	.712	.715	.710	.708	.701	.692	.680	.669	.660	.657	.657	.659	.667	.675	.691	.695	.699	.698	.689
Philadelphia, Pa.....	29.921	.920	.916	.917	.924	.930	.939	.948	.945	.940	.932	.919	.907	.891	.877	.875	.873	.875	.881	.890	.902	.908	.911	.913	.910
Pittsburg, Pa.....	29.133	.129	.128	.133	.140	.148	.158	.165	.166	.163	.156	.150	.139	.125	.113	.105	.105	.104	.107	.111	.120	.137	.131	.132	.133
Portland, Oreg.....	29.868	.872	.872	.872	.871	.872	.874	.879	.885	.889	.893	.894	.892	.889	.878	.875	.868	.861	.856	.853	.853	.856	.865	.875	.873
St. Louis, Mo.....	29.362	.358	.360	.361	.368	.382	.394	.396	.401	.402	.395	.389	.379	.368	.360	.344	.335	.330	.338	.344	.354	.365	.368	.371	.368
St. Paul, Minn.....	28.949	.950	.947	.949	.953	.956	.967	.975	.978	.977	.977	.975	.967	.960	.955	.945	.939	.935	.931	.934	.942	.953	.961	.961	.956
Salt Lake City, Utah.....	25.566	.568	.563	.562	.562	.559	.561	.566	.578	.583	.588	.588	.588	.584	.578	.566	.559	.555	.552	.550	.547	.543	.560	.563	.566
San Diego, Cal.....	29.996	.994	.990	.981	.976	.969	.966	.960	.950	.945	.935	.925	.914	.907	.891	.876	.861	.846	.830	.814	.802	.809	.820	.836	.821
San Francisco, Cal.....	29.916	.917	.914	.916	.924	.938	.955	.965	.965	.958	.945	.934	.924	.910	.895	.879	.863	.846	.830	.814	.802	.806	.808	.807	.810
Savannah, Ga.....	29.984	.975	.975	.978	.983	.999	.012	.018	.024	.023	.016	.003	.986	.968	.955	.949	.943	.946	.956	.965	.979	.989	.999	.998	.984
Washington, D. C....	29.935	.930	.929	.928	.937	.946	.955	.957	.959	.957	.954	.946	.930	.917	.901	.894	.889	.891	.895	.904	.917	.923	.925	.926	.927

TABLE VII.—Average wind movement for each hour of seventy-fifth meridian time, May, 1896.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Abilene, Tex.	13.6	13.6	13.6	12.6	12.2	11.8	11.7	12.1	13.7	16.4	16.3	15.9	16.1	15.4	15.0	14.9	15.4	15.3	15.2	14.5	11.8	11.0	12.0	13.8	13.9
Albany, N. Y.	6.8	6.5	6.4	6.2	6.2	6.1	7.3	8.9	9.8	10.3	10.9	11.2	11.4	12.0	12.6	12.0	11.5	11.5	9.6	7.6	6.8	7.1	7.3	7.1	8.9
Alpena, Mich.	8.4	8.6	8.0	8.0	8.5	8.8	9.2	10.7	11.6	12.0	12.7	13.5	13.9	14.3	13.7	14.5	13.5	11.8	10.7	9.4	7.7	7.3	7.4	7.5	10.5
Amarillo, Tex.	30.8	30.4	30.9	19.1	18.4	17.5	17.8	17.5	18.8	20.4	20.5	19.8	20.2	19.9	19.4	18.6	19.0	20.0	20.2	19.7	20.6	19.7	19.2	20.5	19.5
Atlanta, Ga.	7.5	7.3	7.1	7.3	7.8	7.2	6.5	6.5	7.2	7.3	7.4	8.3	8.4	9.0	9.1	9.5	9.7	9.2	9.2	7.7	7.1	8.3	8.5	7.5	7.9
Augusta, Ga.	3.2	2.7	2.6	2.9	2.6	2.0	2.2	3.8	4.1	4.5	5.1	5.7	6.1	7.0	7.1	7.3	7.1	6.3	5.5	4.7	4.0	3.6	3.8	3.1	4.5
Baker City, Ore.	4.2	4.7	4.5	4.2	4.3	4.0	4.0	4.3	3.8	3.9	4.7	5.3	5.8	6.3	6.5	6.9	7.1	7.3	7.3	7.6	7.2	5.7	4.2	3.6	5.3
Baltimore, Md.	6.4	6.4	6.2	6.0	5.7	5.5	6.5	7.4	7.5	8.5	9.4	9.7	10.0	10.0	10.1	9.6	9.1	8.8	7.1	6.6	6.7	6.6	6.8	6.2	7.6
Bismarck, N. Dak.	8.7	9.0	9.2	9.1	9.4	8.9	9.2	9.5	10.9	13.1	15.5	16.0	16.4	16.5	17.1	16.0	15.8	14.3	14.4	13.1	11.0	10.1	9.3	8.6	12.1
Block Island, R. I.	11.9	11.9	10.9	10.0	10.4	10.5	11.9	14.2	15.4	15.5	16.0	16.8	17.4	18.1	18.6	18.7	18.1	16.6	15.6	15.2	15.0	14.5	13.5	13.3	14.6
Boston, Mass.	8.4	8.3	7.7	7.6	7.8	7.9	8.5	9.9	11.4	11.7	13.0	13.6	13.4	14.2	14.5	13.9	13.5	12.4	11.2	10.5	10.0	9.4	9.4	8.6	10.7
Buffalo, N. Y.	13.6	13.2	13.2	13.3	13.7	13.1	13.1	13.8	15.0	14.5	14.8	15.4	13.9	16.3	16.8	16.7	17.2	15.6	14.6	14.1	14.3	14.2	13.8	13.2	14.6
Calro, Ill.	5.3	6.0	6.1	6.4	6.2	6.5	5.9	6.3	7.9	8.5	8.2	8.4	8.8	9.0	9.7	10.0	9.4	8.4	7.4	6.9	6.0	6.0	5.8	5.9	7.3
Cape Henry, Va.	11.9	10.9	10.5	11.5	11.5	11.3	11.8	12.4	12.8	12.6	12.5	13.4	13.0	12.4	12.0	11.4	10.9	10.5	9.9	10.5	11.0	11.0	11.6	11.5	11.7
Charleston, S. C.	7.0	6.2	6.0	5.6	6.0	5.5	6.3	7.6	7.9	7.7	8.1	9.0	10.2	10.8	11.4	11.8	11.4	10.1	8.9	7.2	6.7	6.2	6.6	6.8	8.0
Charlotte, N. C.	5.5	4.9	5.2	5.2	5.0	4.9	4.9	6.1	6.2	6.5	6.9	7.7	8.2	8.3	8.8	8.4	8.0	7.6	6.5	5.6	5.5	6.1	6.3	5.6	6.4
Chattanooga, Tenn.	4.3	4.2	4.2	3.6	3.5	4.0	3.9	3.6	3.1	3.9	6.5	7.7	7.8	8.5	8.6	8.4	8.0	7.6	6.5	5.6	5.3	3.8	4.0	4.0	5.7
Cheyenne, Wyo.	9.5	9.7	9.8	10.1	9.5	9.4	9.4	9.5	10.0	12.5	14.8	15.4	16.6	17.9	18.6	19.3	19.5	19.4	18.8	18.2	14.6	11.0	10.3	9.7	13.5
Chicago, Ill.	17.4	18.1	18.2	17.0	16.3	16.2	16.9	16.8	17.7	19.0	19.7	20.5	20.3	20.5	21.5	21.5	21.1	19.9	19.0	18.2	14.6	16.7	16.3	17.1	18.5
Cincinnati, Ohio	4.2	4.3	5.0	4.7	4.9	4.0	4.0	5.3	6.8	7.2	8.1	8.9	8.8	9.9	10.4	9.7	9.1	8.8	8.2	7.5	6.4	6.0	4.8	4.3	6.7
Cleveland, Ohio	12.3	11.8	10.5	10.2	10.5	10.9	10.5	10.9	12.5	13.3	15.8	16.6	16.0	16.7	15.7	14.7	13.4	11.6	10.3	9.7	8.9	10.1	11.1	11.7	12.4
Columbia, Mo.	7.4	7.3	7.2	7.4	6.9	6.5	6.7	7.0	7.6	8.6	9.7	10.1	9.9	11.2	11.3	11.1	10.6	10.5	9.4	8.2	7.7	8.5	8.5	8.1	8.6
Columbus, Ohio	4.5	4.7	4.2	4.7	4.1	4.1	4.0	4.8	5.5	6.4	7.2	7.3	7.3	7.7	8.1	7.9	7.7	7.6	6.2	5.5	5.6	5.3	5.0	5.0	5.8
Concordia, Kans.	7.6	8.5	8.4	7.9	8.6	8.4	8.1	8.5	9.7	11.2	11.8	11.8	11.7	12.6	13.3	12.9	12.2	11.7	10.0	7.7	6.4	5.8	7.1	8.2	9.6
Corpus Christi, Tex.	17.1	16.1	14.8	13.6	13.3	13.7	12.7	13.3	13.8	15.0	15.0	16.3	17.6	18.4	19.0	19.6	20.6	20.3	20.9	20.2	19.7	19.5	18.6	17.8	16.9
Davenport, Iowa	8.4	7.8	8.4	8.2	8.5	8.0	7.8	8.7	10.0	10.7	11.2	11.6	12.1	12.8	13.3	13.1	13.4	11.8	10.7	9.3	8.2	7.7	8.5	7.8	9.9
Denver, Colo.	7.6	7.3	6.8	7.3	6.1	6.1	6.5	7.0	6.8	6.9	8.0	8.3	9.4	10.1	10.7	12.1	13.1	14.2	13.5	13.0	11.3	10.3	10.0	9.1	9.3
Des Moines, Iowa	7.4	6.7	6.7	6.6	6.4	5.4	5.4	6.4	7.5	9.3	10.3	11.5	12.5	13.8	13.0	13.3	13.9	13.1	11.6	9.2	8.2	8.2	7.6	8.3	9.2
Detroit, Mich.	8.9	8.7	8.9	8.6	9.0	9.0	10.1	11.7	11.6	11.8	13.6	14.0	14.2	14.7	14.6	14.1	13.5	12.5	11.3	9.9	8.5	8.6	8.6	8.7	11.1
Dodge City, Kans.	13.9	13.6	13.8	12.8	12.5	12.7	11.7	11.7	13.7	16.6	17.3	17.8	18.1	18.6	18.6	18.7	18.5	18.1	17.1	15.6	13.6	13.0	14.2	15.0	13.3
Duluth, Minn.	7.2	8.4	9.6	10.1	9.9	9.9	9.2	9.2	9.8	10.8	12.1	13.7	13.0	14.4	14.5	15.2	14.5	13.5	12.0	10.8	9.6	8.8	8.2	8.1	11.0
Eastport, Me.	8.1	8.9	9.6	9.5	9.0	8.4	8.1	8.8	9.1	10.0	10.5	11.8	12.3	13.0	13.5	13.0	12.2	11.8	10.6	10.5	9.4	9.0	9.0	7.9	10.1
El Paso, Tex.	12.6	12.7	12.6	11.5	11.7	11.5	11.2	12.0	10.4	10.6	11.9	13.2	14.3	14.4	14.2	15.6	17.2	16.7	17.1	18.2	17.0	13.1	12.5	12.0	13.5
Erie, Pa.	11.2	11.1	10.6	10.7	10.5	10.4	10.6	10.5	11.5	12.4	12.9	12.6	13.3	14.3	13.9	13.3	11.9	10.5	10.1	9.2	8.4	9.3	10.5	10.0	11.2
Eureka, Cal.	8.2	7.1	7.3	7.0	7.0	6.6	7.4	6.4	6.0	6.2	7.2	8.6	10.4	11.8	13.0	14.4	15.2	15.1	14.8	14.0	12.1	10.9	9.7	8.6	9.8
Fort Canby, Wash.	12.4	11.0	11.1	12.2	12.1	11.6	10.5	10.3	10.4	9.7	10.0	9.6	10.4	12.2	13.0	13.0	14.0	14.2	13.9	13.3	13.5	13.2	12.5	13.6	12.0
Fort Smith, Ark.	6.2	5.7	5.9	5.7	5.9	6.5	5.3	5.5	6.3	7.1	8.4	9.5	9.7	10.4	10.1	10.8	9.9	10.1	8.5	6.8	5.5	6.1	5.8	5.8	7.4
Fresno, Cal.	10.1	10.4	9.5	8.5	8.2	7.5	6.4	5.8	5.6	6.3	6.9	6.4	5.9	5.9	5.7	6.3	6.7	7.0	7.8	8.9	9.6	9.9	9.9	10.5	7.7
Galveston, Tex.	11.6	11.5	11.1	11.9	11.2	10.7	10.8	10.8	11.6	12.2	12.6	12.2	13.4	13.6	13.4	13.4	13.1	12.6	12.2	12.0	12.1	11.9	11.6	12.1	12.1
Grand Haven, Mich.	9.0	9.3	9.3	9.3	9.6	9.8	10.1	10.7	11.4	12.0	12.7	13.2	12.3	12.3	12.0	11.6	11.6	10.5	10.4	9.1	8.6	8.5	9.1	8.9	10.5
Greenbay, Wis.	7.2	7.0	7.2	7.3	7.3	6.6	7.4	8.6	9.3	10.2	11.0	12.2	12.0	12.5	13.4	13.3	12.9	12.4	10.8	9.7	7.9	7.7	7.0	6.6	9.5
Hannibal, Mo.	10.0	9.4	9.0	9.0	7.6	7.8	8.3	8.1	10.0	10.8	12.5	13.4	12.9	13.5	13.9	13.7	13.7	12.9	10.9	8.3	7.3	9.0	7.2	9.2	10.5
Harrisburg, Pa.	6.1	5.7	5.3	5.2	5.0	5.1	5.5	5.8	7.1	8.5	8.6	8.7	9.0	9.1	9.4	9.0	8.9	8.1	6.8	6.0	6.1	6.1	5.6	5.7	7.0
Hatteras, N. C.	10.5	9.8	9.7	9.0	9.3	9.5	9.9	10.5	11.9	12.1	12.6	12.8	13.5	14.1	14.3	14.6	13.6	12.8	12.6	11.5	12.2	11.8	11.2	11.5	11.7
Havre, Mont.	6.5	6.3	7.5	7.4	7.4	7.6	7.3	8.3	10.3	11.7	12.3	12.0	12.2	13.0	12.9	13.6	14.0	13.5	12.7	10.7	9.6	7.7	6.4	6.5	9.9
Helena, Mont.	8.7	9.0	9.4	8.9	8.4	7.9	7.5	6.0	5.8	5.7	6.5	7.1	9.6	10.3	11.3	11.9	11.9	12.1	11.8	12.1	11.0	9.7	7.8	8.0	9.1
Huron, S. Dak.	13.5	14.6	13.6	12.1	12.8	13.1	13.4	14.6	17.0	18.7	18.9	18.2	18.3	18.4	18.6	19.2	18.4	18.0	17.3	14.5	12.8	12.7	12.0	12.5	15.6
Idaho Falls, Idaho	7.0	7.2	7.5	7.0	6.7	6.7	6.4	6.8	7.4	8.9	10.2	10.5	10.2	10.4	10.8	11.4	12.7	12.9	12.4	11.5	11.1	10.3	9.3	8.8	9.4
Indianapolis, Ind.	4.3	4.1	4.2	4.0	4.2	4.2	4.4	4.9	4.8	5.9	6.9	7.3	7.8	8.2	8.0	8.1	7.6	6.9	5.4	4.8	5.6	5.3	5.2	5.8	5.8
Jacksonville, Fla.	6.1	5.8	5.7	5.9	6.1	5.5	5.1	6.5	7.4	7.2	6.7	6.7	7.7	8.6	8.9	10.2	10.3	10.9	10.0	8.3	6.9	6.7	7.1	6.8	7.4
Jupiter, Fla.	9.1	8.9	8.7	8.1	8.0	7.6	7.3	7.7	8.5	9.1	10.4	11.1	12.0	11.8	12.1	11.5	11.0	10.9	9.6	9.5	9.8	9.5	10.0	9.7	9.7
Kansas City, Mo.	7.1	7.3	6.9	7.0	7.4	7.2	7.5	8.2	9.6	10.5	10.6	11.3	12.2	12.5	12.8	13.2	12.9	11.5	10.9	9.8	8.4	7.8	7.5	7.9	9.5
Keokuk, Iowa	7.9	7.5	7.4	6.1	5.9	6.1	6.5	7.3	8.0	8.9	9.7	11.0	10.9	11.4	11.2	11.5	10.3	10.6	9.5	8.5					

TABLE VII.—Average wind movement, etc.—Continued.

Stations.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon.	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Midnight.	Mean.
Philadelphia, Pa.....	7.8	7.9	7.9	8.5	7.5	8.0	8.2	9.2	10.1	10.9	11.5	11.6	11.8	12.4	12.7	12.5	12.0	11.1	10.3	9.4	9.0	8.4	8.2	8.6	9.8
Phoenix, Ariz.....	4.1	3.8	4.0	4.0	4.6	4.5	4.5	5.3	4.9	5.5	5.0	5.0	4.9	6.0	6.5	7.6	8.6	9.3	9.1	8.4	6.6	5.1	5.2	4.3	5.5
Pierre, S. Dak.....	11.0	9.9	8.6	9.6	9.3	8.5	9.0	9.5	11.7	13.7	13.9	13.4	13.7	14.2	14.5	14.6	14.3	14.2	14.0	13.0	11.5	10.7	10.7	10.0	11.1
Pittsburg, Pa.....	4.5	4.5	4.5	4.1	4.1	4.2	4.4	5.5	6.2	6.9	7.0	6.9	7.7	8.2	8.5	8.7	8.6	7.9	6.9	6.1	5.8	5.5	4.6	4.4	6.8
Port Angeles, Wash.....	4.7	5.4	5.4	5.5	5.0	5.2	4.5	4.8	4.9	4.3	5.0	6.2	7.6	7.9	8.5	7.6	7.6	8.6	8.9	10.3	10.4	9.2	7.7	6.3	6.7
Port Huron, Mich.....	9.4	9.4	10.3	9.9	8.9	8.9	9.7	10.7	11.9	12.5	13.7	13.8	15.0	15.3	15.6	15.4	14.8	13.3	11.8	10.1	10.1	10.0	10.0	9.8	11.7
Portland, Me.....	4.9	5.1	5.3	4.9	5.4	4.9	5.2	6.2	7.3	8.5	9.4	10.3	11.0	11.1	11.0	10.5	9.5	8.5	6.8	5.7	6.1	5.1	4.6	4.5	7.2
Portland, Oreg.....	9.5	8.7	8.8	8.9	8.2	8.0	7.6	8.4	8.5	8.7	9.0	9.3	8.7	9.1	9.7	10.0	9.7	9.4	10.0	9.7	9.9	10.3	9.6	10.1	9.2
Pueblo, Colo.....	7.9	7.4	7.0	6.1	6.2	5.4	5.0	4.8	4.7	6.0	7.5	8.9	9.6	10.7	12.4	13.6	14.5	14.7	15.0	14.6	12.7	10.5	9.0	8.0	9.3
Raleigh, N. C.....	3.7	3.8	3.9	4.1	4.1	4.3	4.6	5.6	6.5	6.9	6.7	6.0	6.2	7.0	6.5	6.5	6.0	5.9	4.6	4.5	3.9	4.0	4.2	3.5	5.1
Rapid City, S. Dak.....	7.5	8.4	9.7	9.1	9.8	9.5	9.5	8.9	9.1	10.8	13.1	14.2	13.7	14.1	13.3	13.3	13.8	13.6	13.4	13.8	11.6	8.3	8.1	7.9	11.0
Redbluff, Cal.....	7.3	7.4	7.5	7.6	6.7	6.4	6.3	6.8	7.3	8.0	9.6	10.5	10.8	10.3	9.5	9.4	9.1	9.2	9.0	8.5	8.2	7.7	7.1	7.5	8.2
Rochester, N. Y.....	6.6	6.4	6.6	6.5	6.4	6.1	6.9	8.0	8.5	9.2	10.0	10.4	11.4	11.3	12.0	11.9	11.8	10.3	8.5	7.6	6.7	6.4	6.4	6.6	8.4
Roseburg, Oreg.....	3.7	3.2	3.1	3.1	2.7	2.7	2.5	2.7	2.8	2.8	3.8	4.5	4.9	5.6	6.0	7.1	7.0	8.2	8.4	7.7	7.8	7.0	5.3	4.4	4.9
Sacramento, Cal.....	9.1	9.1	8.3	8.3	9.1	9.7	9.4	9.1	9.1	9.2	10.2	10.6	11.6	11.6	11.9	12.5	12.3	12.4	12.1	11.7	11.1	11.5	11.0	10.1	10.5
St. Louis, Mo.....	9.7	10.1	9.7	8.9	8.5	7.8	8.1	8.5	8.9	9.9	10.5	11.3	11.9	12.3	12.8	13.1	13.9	14.0	13.5	11.3	9.9	9.5	10.1	10.3	10.6
St. Paul, Minn.....	6.8	7.2	6.9	6.6	7.4	6.8	6.3	7.4	8.4	9.3	10.3	10.5	11.2	11.8	12.1	12.3	12.0	11.7	10.5	9.6	8.0	7.3	7.4	7.5	9.0
Salt Lake City, Utah.....	5.1	5.5	4.8	3.7	4.4	4.5	4.5	4.6	4.3	4.4	5.5	7.0	8.3	8.8	9.2	11.0	11.2	10.8	9.4	7.8	7.1	5.8	6.0	3.3	6.7
San Antonio, Tex.....	10.5	8.8	8.1	8.2	7.5	6.7	6.5	6.7	9.1	10.5	10.9	10.9	11.5	11.9	12.1	12.1	12.0	11.8	12.7	12.9	12.7	13.6	13.1	11.8	10.5
San Diego, Cal.....	3.4	3.3	3.4	3.6	3.5	3.6	3.6	3.4	3.6	3.7	4.5	5.6	7.7	9.0	10.3	10.6	10.4	10.6	10.1	9.0	7.7	6.0	4.6	4.1	6.1
Sandusky, Ohio.....	7.6	7.1	7.3	7.6	7.6	7.1	6.9	7.8	8.3	9.2	9.9	9.9	10.1	9.8	9.7	10.2	9.9	8.9	8.4	7.5	6.9	6.4	7.1	7.1	8.3
San Francisco, Cal.....	10.5	9.6	9.0	7.8	7.5	7.6	7.1	8.2	7.7	8.0	8.8	9.5	10.9	13.0	15.0	17.3	18.8	18.9	19.7	19.4	18.6	16.6	14.2	12.7	12.4
San Luis Obispo, Cal.....	3.7	3.4	3.6	3.8	4.2	4.5	4.4	4.2	4.4	5.1	5.8	7.0	7.4	8.3	10.3	10.9	11.4	11.6	10.8	11.1	9.5	8.2	6.2	4.7	6.9
Santa Fe, N. Mex.....	5.7	5.7	5.8	5.5	5.2	5.0	5.1	5.5	5.3	6.8	8.6	9.8	10.5	11.0	12.8	14.0	15.6	15.7	14.6	13.1	10.9	7.8	6.5	6.0	8.9
Sault Ste Marie, Mich.....	6.6	6.2	6.6	7.1	7.2	8.3	8.7	9.3	10.6	10.8	11.5	12.6	13.4	13.7	13.9	13.5	14.0	13.2	11.4	9.8	9.2	7.4	7.1	7.1	10.0
Savannah, Ga.....	6.5	6.0	5.6	5.5	5.3	5.3	6.4	6.8	6.8	6.5	5.9	6.5	7.6	9.0	10.3	10.7	9.8	10.0	8.7	8.0	7.7	7.0	6.5	6.3	7.3
Seattle, Wash.....	3.9	4.1	4.7	4.7	4.7	4.5	4.3	4.4	4.5	4.8	4.7	5.0	5.5	5.9	6.1	6.5	6.3	6.7	7.2	7.2	7.5	6.7	5.8	4.8	5.4
Shreveport, La.....	7.0	6.4	5.6	5.0	5.4	5.5	4.8	5.3	6.5	7.3	7.7	7.8	8.1	8.8	8.8	9.3	8.8	9.0	8.1	5.9	5.7	6.7	6.5	6.9	7.0
Sioux City, Iowa.....	10.1	9.6	10.3	9.7	10.2	10.5	9.8	10.5	12.1	13.7	14.8	14.6	14.8	16.1	16.8	16.6	16.4	16.0	15.2	12.7	10.8	9.8	10.6	10.4	12.6
Spokane, Wash.....	4.6	4.7	5.0	5.0	5.3	5.7	5.7	6.2	5.8	6.3	6.5	6.7	7.4	7.7	8.3	9.4	10.3	9.7	9.1	8.8	8.4	6.7	5.6	4.7	6.8
Springfield, Ill.....	8.9	8.9	8.9	9.1	9.0	8.5	8.2	8.8	9.8	10.5	11.5	11.5	11.8	12.5	13.0	12.6	13.1	12.0	11.7	10.4	9.4	8.5	8.4	8.7	10.2
Springfield, Mo.....	11.4	11.6	11.0	10.4	10.3	10.0	9.9	10.9	11.7	12.8	13.3	13.0	12.8	12.9	14.1	13.9	13.5	12.5	11.0	9.7	9.8	10.9	11.2	11.0	11.7
Tampa, Fla.....	4.2	4.4	4.2	4.0	4.5	4.6	4.8	5.4	5.8	6.3	6.3	6.6	6.9	8.5	8.5	9.6	9.5	9.3	7.6	5.8	4.9	4.4	4.2	4.8	6.0
Tatoosh Island, Wash.....	10.9	10.7	10.5	10.5	11.2	11.4	10.2	10.7	10.3	10.1	11.0	11.3	11.3	11.1	12.3	13.2	13.1	12.6	12.0	11.6	11.1	12.1	10.7	10.7	11.3
Toledo, Ohio.....	8.1	8.4	8.6	7.7	8.0	8.1	9.5	10.5	10.5	11.3	11.8	12.4	12.4	12.6	12.8	12.3	12.7	12.5	11.0	8.6	7.3	7.8	8.1	8.4	10.1
Vicksburg, Miss.....	6.3	6.0	6.0	5.9	5.5	5.4	5.2	5.4	5.7	6.2	6.4	6.6	7.1	7.6	7.7	8.1	8.0	6.9	5.9	4.8	5.1	5.9	6.0	6.5	6.3
Vineyard Haven, Mass.....	7.3	6.7	7.1	6.7	6.6	7.2	7.8	9.1	9.6	10.5	11.1	11.8	12.1	12.3	11.2	10.5	9.8	8.8	7.9	7.6	7.4	7.6	7.2	9.0	9.0
Walla Walla, Wash.....	6.6	6.1	6.0	5.5	6.0	6.1	5.9	5.7	6.4	6.8	7.8	8.9	8.5	8.4	9.5	9.4	9.5	8.2	8.0	7.5	7.0	6.9	7.3	7.4	7.4
Washington, D. C.....	4.7	4.6	4.3	5.0	4.8	4.4	4.7	6.1	7.2	7.4	7.6	8.1	8.3	8.2	8.0	7.8	7.1	6.5	5.9	5.9	5.3	4.5	4.6	4.4	6.1
Wichita, Kans.....	9.5	9.7	9.7	9.0	9.1	9.0	8.4	9.5	11.4	12.6	13.2	13.8	13.9	13.2	13.4	13.1	13.6	14.1	13.5	11.9	10.7	10.6	10.2	9.5	11.4
Williston, N. Dak.....	9.1	7.9	8.4	9.0	8.8	8.5	8.6	8.8	10.1	11.9	13.9	15.1	14.3	15.3	15.9	16.7	16.0	15.2	14.8	15.0	13.4	11.6	10.5	9.9	12.0
Wilmington, N. C.....	6.5	6.3	6.1	5.8	5.6	5.8	6.3	7.3	8.1	8.4	8.7	8.5	9.1	10.8	11.5	12.1	12.2	10.6	9.5	8.5	7.6	7.9	8.0	7.3	8.3
Winnemucca, Nev.....	9.0	8.7	9.1	8.2	8.2	8.2	8.0	9.5	8.6	9.2	11.4	10.7	12.6	12.3	13.1	13.6	15.0	14.0	13.5	12.8	11.3	9.1	8.5	7.7	10.5
Woods Hole, Mass.....	10.4	9.5	9.6	9.1	9.0	10.0	10.8	12.5	14.2	14.9	14.5	15.9	16.5	16.6	16.4	15.8	14.6	13.9	12.3	12.3	12.2	11.7	10.8	11.7	12.7
Yuma, Ariz.....	8.1	7.2	6.5	5.6	6.3	5.3	4.8	5.3	5.3	5.8	8.0	8.9	9.5	10.0	9.6	9.4	9.7	9.8	10.5	10.7	11.3	11.5	10.9	10.7	8.4

TABLE VIII.—*Heights of rivers above low-water mark, May, 1896.*

Stations.	Distance to mouth of river.	Danger- point on gauger.	Highest water.		Lowest water.		Me'n stage.	Monthly range.	Stations.	Distance to mouth of river.	Danger- point on gauger.	Highest water.		Lowest water.		Me'n stage.	Monthly range.
			Height.	Date.	Height.	Date.						Height.	Date.	Height.	Date.		
<i>Mississippi River.</i>																	
St. Paul, Minn.....	Miles. 2,087	Feet. 14.0	Feet. 10.5	21, 22	Feet. 7.9	1	Feet. 9.3	Feet. 2.6	Big Sandy River.	Miles. 26	Feet.	Feet. 5.0	3, 7	Feet. 2.9	19	Feet. 3.7	Feet. 2.1
La Crosse, Wis.....	1,867	10.0	10.7	24, 25	9.2	16, 31	9.9	1.5	Louisa, Ky.....	.....	.....	.....	.....	.....	.....	.....	.....
Dubuque, Iowa.....	1,759	15.0	13.9	29	10.9	30	12.2	3.0	<i>Wabash River</i>								
Davenport, Iowa.....	1,653	15.0	12.0	28-30	8.8	23-25	9.8	3.2	Mount Carmel, Ill. . .	50*	15.0	6.5	31	1.8	16, 17	3.3	4.7
Keokuk, Iowa.....	1,523	14.0	11.4	31	7.0	1	9.5	5.0	<i>Cumberland River.</i>								
Hannibal, Mo.....	1,422	17.0	12.8	22, 23	7.2	1	10.5	5.6	Burnside, Ky.....	404	50.0	3.8	25	0.9	20	1.9	2.9
St. Louis, Mo.....	1,321	30.0	27.7	26	13.6	1	18.8	14.1	Nashville, Tenn.....	145	40.0	6.6	29	2.4	10, 25	4.1	4.2
Memphis, Tenn.....	910	33.0	23.6	31	10.4	1	14.0	13.2	<i>Tennessee River.</i>								
Helena, Ark.....	834	37.0	30.6	31	17.0	2, 3	20.3	13.6	Knoxville, Tenn.....	640	29.0	.....	.....	.....	.....	.....	.....
Arkansas City, Ark.....	702	42.0	32.8	31	19.3	23	22.9	13.5	Chattanooga, Tenn.....	455	33.0	4.6	.....	.....	.....	.....	.....
Greenville, Miss.....	662	40.0	27.2	31	15.8	23	18.7	11.4	Johnsonville, Tenn....	94	21.0	7.5	6, 7	2.1	21, 22	3.1	2.5
Vicksburg, Miss.....	541	41.0	27.4	31	17.5	24	21.1	9.9	<i>Arkansas River.</i>				2, 3	2.6	26, 27	4.3	4.9
New Orleans, La.....	108	13.0	12.6	1	6.4	27	8.4	6.2	Fort Smith, Ark.....	351	22.0	17.8	24	3.2	18	8.9	14.6
<i>Missouri River.</i>																	
Pierre, S. Dak.....	1,132	18.0	6.3	16	2.3	13, 14	3.5	4.0	Little Rock, Ark.....	176	23.0	18.8	26	5.8	18	10.3	13.0
Sioux City, Iowa.....	802	18.7	11.3	19	7.7	27	8.6	3.6	<i>Red River.</i>								
Omaha, Nebr.....	667	18.0	11.4	20	8.7	1-9, 95	9.5	2.7	Shreveport, La.....	449	29.2	8.0	25	1.6	17	4.2	6.4
Kansas City, Mo.....	386	21.0	19.2	22	9.7	15	13.2	9.5	<i>James River.</i>								
<i>Ohio River.</i>																	
Parketsburg, W. Va..	786	38.0	10.7	5	5.0	21	7.1	5.7	Lynchburg, Va.....	251	18.0	4.6	3	0.6	30	1.6	4.0
Catlettsburg, Ky.....	652	50.0	16.1	7	4.4	23	9.2	11.7	<i>Congaree River.</i>								
Cincinnati, Ohio.....	500	45.0	17.8	9	7.8	25	12.3	10.0	Columbia, S. C.....	.....	15.0	3.6	5	0.2	15, 18, 20	1.1	3.4
Louisville, Ky.....	368	24.0	7.7	10	4.4	26	6.3	3.3	<i>Savannah River.</i>								
Evansville, Ind.....	184	30.0	12.2	3, 4	6.2	22, 23	9.7	6.0	Augusta, Ga.....	140	22.6	10.6	5	4.9	23	6.6	5.7
Paducah, Ky.....	47	40.0	17.9	31	7.2	30	11.4	10.7	<i>Alabama River.</i>								
Cairo, Ill.....	1,140*	40.0	32.3	30	17.5	19	22.6	14.8	Montgomery, Ala.....	215	48.0	7.0	5	0.9	23	2.9	6.1
<i>Monongahela River.</i>																	
Pittsburg, Pa.....	966†	22.0	7.9	30	2.7	11	5.3	5.2	<i>Williamette River.</i>								
<i>Great Kanawha River.</i>																	
Charleston, W. Va....	61	30.0	7.7	5	4.3	11, 12	5.6	3.4	Portland, Oreg.....	.....	15.0	14.8	31	8.3	1	11.1	6.5
<i>Sacramento River.</i>																	
									Redbluff, Cal.....	.....	20.0	16.9	4	5.8	21	8.6	11.1
									Sacramento, Cal.....	.....	28.0	22.8	14	21.5	21-25	22.0	1.3

*To mouth of Mississippi River.

†To mouth of Ohio River.

TABLE IX.—Resultant winds from observations at 8 a. m. and 8 p. m., daily, during May, 1896.

Stations.	Component direction from—				Resultant.		Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.		N.	S.	E.	W.	Direction from—	Duration.
<i>New England.</i>							<i>Upper Lake Region—Cont'd.</i>						
Eastport, Me.	19	24	13	13	s. 45 w.	5	Milwaukee, Wis.	12	23	22	21	s. 5 e.	11
Portland, Me.	17	30	7	30	s. 50 w.	18	Greenbay, Wis.	13	29	18	20	s. 7 w.	16
Northfield, Vt.	20	29	5	10	s. 34 w.	6	Duluth, Minn.	33	10	23	15	n. 19 e.	24
Boston, Mass.	14	20	30	24	s. 59 w.	7	<i>North Dakota.</i>						
Nantucket, Mass.	12	21	13	28	s. 18 w.	18	Moorhead, Minn.	21	22	11	21	s. 84 w.	10
Woods Hole, Mass.*	5	17	7	11	s. 33 w.	13	Bismarck, N. Dak.	24	12	23	14	n. 37 e.	15
Block Island, R. I.	9	23	20	29	s. 24 e.	17	Williston, N. Dak.	24	9	21	21	n.	15
New Haven, Conn.	15	27	15	15		12	<i>Upper Mississippi Valley.</i>						
<i>Middle Atlantic States.</i>							St. Paul, Minn.	14	27	18	24	s. 25 w.	14
Albany, N. Y.	13	30	8	15	s. 25 w.	17	La Crosse, Wis.†	4	20	6	6	s.	16
New York, N. Y.	14	22	19	23	s. 27 w.	9	Davenport, Iowa	10	21	25	19	s. 29 e.	12
Harrisburg, Pa.	6	17	19	26	s. 32 w.	13	Des Moines, Iowa	14	27	16	15	s. 4 e.	13
Philadelphia, Pa.	18	15	17	28	n. 75 w.	11	Keokuk, Iowa	10	34	17	18	s. 2 w.	24
Baltimore, Md.	14	24	19	21	s. 11 w.	10	Calro, Ill.	9	32	20	16	s. 10 e.	23
Washington, D. C.	16	23	17	19	s. 16 w.	7	Springfield, Ill.	4	39	8	16	s. 13 w.	26
Lynchburg, Va.	14	23	22	20	s. 13 e.	9	Hannibal, Mo.	10	36	13	18	s. 11 w.	26
Norfolk, Va.	15	24	22	18	s. 24 e.	10	St. Louis, Mo.	7	40	18	10	s. 14 e.	34
<i>South Atlantic States.</i>							<i>Missouri Valley.</i>						
Charlotte, N. C.	13	30	22	10	s. 35 e.	21	Columbia, Mo.*	4	17	11	7	s. 17 e.	14
Hatteras, N. C.	14	27	15	24	s. 35 w.	16	Kansas City, Mo.	8	41	20	10	s. 17 e.	34
Kittyhawk, N. C.	15	23	22	30	s. 14 e.	8	Springfield, Mo.	6	42	18	9	s. 14 e.	37
Raleigh, N. C.	17	27	14	19	s. 27 w.	11	Omaha, Nebr.	20	19	17	19	n. 63 w.	2
Wilmington, N. C.	6	33	16	26	s. 30 w.	29	Sioux City, Iowa†	9	15	9	3	s. 41 e.	9
Charleston, S. C.	2	37	11	23	s. 19 w.	37	Pierre, S. Dak.	21	14	25	18	n. 45 e.	10
Augusta, Ga.	13	25	22	19	s. 14 e.	12	Huron, S. Dak.	22	21	22	17	n. 79 e.	5
Savannah, Ga.	8	40	6	19	s. 22 w.	34	<i>Northern Slope.</i>						
Jacksonville, Fla.	7	35	28	7	s. 37 e.	35	Havre, Mont.	14	17	12	33	s. 82 w.	21
<i>Florida Peninsula.</i>							Miles City, Mont.	24	11	17	19	n. 9 w.	13
Jupiter, Fla.	9	31	33	7	s. 50 e.	34	Helena, Mont.	12	27	5	29	s. 58 w.	28
Key West, Fla.	8	13	50	0	s. 84 e.	50	Rapid City, S. Dak.	18	14	14	26	n. 72 w.	13
Tampa, Fla.	20	12	24	20	n. 27 e.	9	Cheyenne, Wyo.	21	17	6	26	n. 79 w.	20
<i>Eastern Gulf States.</i>							Lander, Wyo.	10	25	12	30	s. 50 w.	23
Atlanta, Ga.	12	23	14	29	s. 54 w.	19	North Platte, Nebr.	15	29	18	17	s. 4 e.	14
Pensacola, Fla.	18	27	9	26	s. 63 w.	20	<i>Middle Slope.</i>						
Mobile, Ala.	20	33	9	9	s.	13	Denver, Colo.	15	30	10	20	s. 34 w.	18
Montgomery, Ala.	13	30	19	18	s. 3 e.	17	Pueblo, Colo.	19	17	18	23	n. 68 w.	5
Meridian, Miss.	13	38	17	11	s. 13 e.	26	Concordia, Kans.	14	29	16	12	s. 15 e.	16
Vicksburg, Miss.	4	32	23	15	s. 16 e.	29	Dodge City, Kans.	23	27	19	5	s. 74 e.	15
New Orleans, La.	3	45	23	7	s. 23 e.	46	Wichita, Kans.	10	33	30	5	s. 31 e.	29
<i>Western Gulf States.</i>							Oklahoma, Okla.	5	46	22	3	s. 25 e.	45
Shreveport, La.	2	43	25	8	s. 22 e.	44	<i>Southern Slope.</i>						
Fort Smith, Ark.	7	21	32	3	s. 64 e.	32	Abilene, Tex.	6	43	15	11	s. 6 e.	37
Little Rock, Ark.	7	40	12	14	s. 3 w.	57	Amarillo, Tex.	9	38	5	14	s. 17 w.	30
Corpus Christi, Tex.	1	41	42	1	s. 46 e.	57	<i>Southern Plateau.</i>						
Galveston, Tex.	0	52	21	2	s. 30 e.	55	El Paso, Tex.	19	13	6	39	n. 80 w.	34
Palestine, Tex.	5	45	18	5	s. 18 e.	42	Santa Fe, N. Mex.	12	26	18	24	s. 23 w.	15
San Antonio, Tex.	1	43	28	2	s. 31 e.	49	Phoenix, Ariz.	5	23	6	36	s. 59 w.	35
<i>Ohio Valley and Tennessee.</i>							Yuma, Ariz.	20	13	10	32	n. 72 w.	23
Chattanooga, Tenn.	9	29	10	28	s. 42 w.	27	<i>Middle Plateau.</i>						
Knoxville, Tenn.	13	13	20	27	w.	7	Carson City, Nev.	18	15	3	42	n. 86 w.	39
Memphis, Tenn.	11	31	23	8	s. 37 e.	25	Winnemucca, Nev.	16	24	10	23	s. 58 w.	15
Nashville, Tenn.	12	30	17	19	s. 6 w.	18	Salt Lake City, Utah.	24	15	19	24	n. 29 w.	10
Lexington, Ky.	9	28	15	25	s. 28 w.	22	<i>Northern Plateau.</i>						
Louisville, Ky.	14	27	17	15	s. 4 w.	13	Baker City, Oreg.	25	21	13	19	n. 56 w.	7
Indianapolis, Ind.	11	28	22	17	s. 16 e.	18	Idaho Falls, Idaho	9	44	8	6	s. 3 e.	35
Cincinnati, Ohio	12	22	26	17	s. 42 e.	14	Spokane, Wash.	10	37	8	21	s. 26 w.	30
Columbus, Ohio	14	24	20	19	s. 11 e.	10	Walla Walla, Wash.	3	47	11	12	s. 1 w.	44
Pittsburg, Pa.	13	20	18	27	s. 52 w.	11	<i>North Pacific Coast Region.</i>						
Parkersburg, W. Va.	12	26	23	14	s. 33 e.	17	Fort Canby, Wash.	18	15	7	32	n. 83 w.	25
<i>Lower Lake Region.</i>							Port Angeles, Wash.	9	21	6	35	s. 68 w.	31
Buffalo, N. Y.	5	22	15	31	s. 43 w.	23	Seattle, Wash.	19	31	14	12	s. 9 e.	12
Oswego, N. Y.	9	27	14	26	s. 34 w.	22	Tatoosh Island, Wash.	6	22	17	30	s. 39 w.	21
Rochester, N. Y.	11	22	12	32	s. 61 w.	23	Portland, Oreg.	15	27	12	25	s. 47 w.	18
Erie, Pa.	11	22	15	28	s. 50 w.	17	Roseburg, Oreg.	24	15	10	27	n. 62 w.	19
Cleveland, Ohio	10	26	21	22	s. 3 w.	16	<i>Middle Pacific Coast Region.</i>						
Sandusky, Ohio	11	16	22	25	s. 31 w.	6	Eureka, Cal.	23	18	11	27	n. 73 w.	17
Toledo, Ohio	0	14	30	29	s. 48 w.	12	Redbluff, Cal.	23	21	13	25	n. 81 w.	12
Detroit, Mich.	7	26	17	29	s. 32 w.	22	Sacramento, Cal.	18	29	10	22	s. 47 w.	16
<i>Upper Lake Region.</i>							San Francisco, Cal.	5	12	1	49	s. 82 w.	48
Alpena, Mich.	12	23	23	20	s. 15 e.	11	<i>South Pacific Coast Region.</i>						
Grand Haven, Mich.	8	28	18	24	s. 17 w.	21	Fresno, Cal.	20	3	2	48	n. 70 w.	49
Marquette, Mich.	22	24	16	17	s. 27 w.	2	Los Angeles, Cal.	18	6	18	31	n. 47 w.	18
Fort Huron, Mich.	14	27	11	30	s. 35 w.	16	San Diego, Cal.	20	13	9	36	n. 75 w.	28
Sault Ste. Marie, Mich.	12	20	25	21	s. 27 e.	9	San Luis Obispo, Cal.	24	6	1	37	n. 63 w.	40
Chicago, Ill.	8	33	13	20	s. 16 w.	26							

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE X.—Thunderstorms and auroras, May, 1896.

States.	No. of stations.																																Total.					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	No.	Days.				
Alabama.....	56	T.	5	5	5	1	3				1				7	1					3	2	6	3	1	3	4		9	1		60	17	T.				
Arizona.....	49	T.																															0	3	A.			
Arkansas.....	51	T.	1	3	4	1	1			1	4		4	6	1	6	4		1	3	4	2	3	1	1	3	3	4	10		4	2	77	25	T.			
California.....	302	T.					1	8	2	1	1								1		2	1	4	1					3	27		53	13	A.				
Colorado.....	80	T.											1	1							1												5	0	T.			
Connecticut.....	18	T.		1		5				1		5						1		8							6		15		2	6	50	10	A.			
Delaware.....	6	T.		1		4						2	2	1		1			4	3	2	1					1		3				25	0	T.			
Dist. of Columbia.....	4	T.		1		1							1						1	1			1				1		1				8	0	A.			
Florida.....	38	T.	7	9	5	13	10	9	6	1					1	2			3	3	6	7	3	2	3	2	2	5	4		3		106	0	T.			
Georgia.....	44	T.	1	3	3	3	6	3							2		1		2		2	4	3	4	4	2	2	6	1		4	1	3	60	31	A.		
Idaho.....	38	T.	2			1		1	1			1	1	1							2	1	1	4	4			1		2	2	1	2	28	17	T.		
Illinois.....	100	T.	26			3					1	16	3	31	10	1	37	19	27	30	20	22	6	2	11	13	6	30	4	2	12	4	236	24	A.			
Indiana.....	41	T.	8	9		2					2	14	8	3	1		8	5	14	11	1	10	2		2	14	4	10	4	1	1	8		132	21	T.		
Indian Territory.....	9	T.	1	1											3	2		3		2													13	0	A.			
Iowa.....	101	T.	5	2	4						1	11	20	22	12	5	7	22	17	8	3	19	3		11	15	2	7	19		1	3		219	23	T.		
Kansas.....	90	T.	2	1	10	8			1	3	9	2	8	15	8	1	15	7	5	6	11	5	11	7	4		3	4	3	1	4	12	8	174	28	A.		
Kentucky.....	46	T.	3	2								2	1	2	3	1	5	2	2	9	3	4	5	1			10	11	7		1	6		80	0	T.		
Louisiana.....	46	T.	5	11	13	3	1		2				1	5	9	9				7	1	3	1	4	5		3	8	3	1			95	0	A.			
Maine.....	17	T.				2	4					10	2																				29	7	T.			
Maryland.....	42	T.		2	1			1		1									10	9	2	2	10										5	4	A.			
Massachusetts.....	82	T.		2	7		13	1				2	13	8	2												10		16	2	1	4	124	19	T.			
Michigan.....	79	T.		5	1														1	1	23		1										1	1	103	1	A.	
Minnesota.....	74	T.	2	4	2	5		2	1		7	12	19	5	23	1	6	15	7	3		2			1	31	2	15	3		10		176	22	T.			
Mississippi.....	47	T.		2	2																													6	8	A.		
Missouri.....	103	T.	8	6		1					2		2						2	5	2					1							22	9	T.			
Montana.....	47	T.	8	8	8	1			2		4				10	5	4	1				6		2			3		9	1	1		73	16	A.			
Missouri.....	103	T.	10		12	4				2	1	13	17	29	13	29	35	10	18	35	30	27	22	19	11	6	32	33	6	9	21	26	470	26	T.			
Montana.....	42	T.					1		2			1					1		1	1	1			3	2	1								14	10	A.		
Nebraska.....	130	T.	3	2	4	3		3	3	6	3	5	12	12	8	5	10	9	7	4	10	7		6	1	1		4	13		3	14	7	165	27	T.		
Nevada.....	50	T.	4																															4	1	A.		
New Hampshire.....	23	T.					10			2	6	2																						28	10	T.		
New Jersey.....	51	T.		1	1			1							1				3	2														10	7	A.		
New Mexico.....	37	T.		3																														15	5	T.		
New York.....	95	T.		3																															0	0	A.	
New York.....	95	T.		3	1	2	3		5			3		1	3	5									3	8	15	3	15	2	2	4		96	30	T.		
North Carolina.....	60	T.	14	12	8	5	6	7		3																								24	5	A.		
North Carolina.....	60	T.	14	12	8	5	6	7		3																								245	27	T.		
North Dakota.....	40	T.		3	3	3	2	2	5	9	8	3	0	2		1		1								8	2	1	3		2			67	20	A.		
Ohio.....	137	T.	10	32	1	3	3				1	33	24	17	22		4	13	37	8	3	10	12	5	1	31	23	7	15	2	25	3	345	25	T.			
Oklahoma.....	23	T.		8	1					1	2	3	4	3	2		2	3		6		2	5											26	6	A.		
Oregon.....	60	T.	1	1	2		1					1																						16	11	T.		
Pennsylvania.....	96	T.		5	8		13			2			16	9	3	13	17	1	2	16	14		1			1	26		26	2	10	5	190	30	A.			
Rhode Island.....	8	T.					1																											7	2	T.		
South Carolina.....	40	T.		1	1																													2	2	A.		
South Carolina.....	40	T.	3	5	6	7	8	1																										109	26	T.		
South Dakota.....	44	T.		2				1	4	2	2		3		1	1																		28	6	A.		
Tennessee.....	51	T.		2																															6	2	T.	
Tennessee.....	51	T.	6	14	2	2	1				2	1		2	1		2	4	1	12	9	4	14	4	2		10	6	9				131	22	A.			
Texas.....	88	T.	6	11	7		1			3	6	3	1	4	3	1	2	2			1													59	19	T.		
Utah.....	38	T.																																	0	0	A.	
Utah.....	38	T.																																	26	0	T.	
Vermont.....	16	T.																																	22	12	T.	
Virginia.....	43	T.		8	4	1	5																												130	21	A.	
Washington.....	54	T.		3	1	2	1																												25	0	T.	
Washington.....	54	T.	3	1	2	1																													25	0	A.	
West Virginia.....	40	T.		1																																104	4	T.
West Virginia.....	40	T.	5	7	2		4																												45	10	A.	
Wisconsin.....	58	T.	18	1						1	10	8	21	24	17	1	8	2	2						2	11	15	3	4	2	1	4		160	23	T.		
Wisconsin.....	58	T.	2																																			

TABLE XI.—Hourly sunshine as deduced from sunshine recorders, May, 1896.

Stations.	Instrument.	Percentages for each hour of local mean time ending with the respective hour.																Monthly summary.			
		A. M.								P. M.								Instrumental record.			
		5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	Actual.	Possible.	Percent of possible.	Personal estimate.
		5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8				
Atlanta, Ga.	T.	37	40	72	91	96	96	98	96	97	97	98	97	94	81	58	50	Hours.	Hours.		
Baltimore, Md.	T.	38	39	29	29	34	46	55	46	40	33	25	23	25	21	19	6	374.0	432.6	86	53
Bismarck, N. Dak.	P.	31	36	40	48	58	57	56	51	50	58	61	57	54	53	34	29	142.8	443.8	32	34
Boston, Mass.	T.	33	43	43	50	59	75	80	81	72	71	60	61	52	44	36	29	229.8	467.4	49	46
Buffalo, N. Y.*	T.	33	36	36	37	50	60	61	67	71	70	74	81	63	49	48	38	262.8	451.9	58	46
Chicago, Ill.	T.	46	46	66	84	88	94	91	90	95	92	86	86	85	57	42	36	305.8	394.5	56	46
Cincinnati, Ohio	T.	48	61	55	67	84	89	92	94	93	92	88	88	88	77	64	42	351.2	443.8	78	66
Cleveland, Ohio	P.	50	41	48	50	73	82	75	49	76	71	72	69	69	54	32	29	355.4	443.8	80	56
Columbus, Ohio	T.	22	29	37	50	59	66	76	81	86	85	70	59	54	42	35	8	277.3	451.9	61	52
Denver, Colo.	P.	31	40	49	53	61	68	69	69	66	61	64	56	53	52	35	50	255.6	446.7	57	43
Des Moines, Iowa	T.	35	39	45	54	61	69	73	75	75	76	73	65	61	55	56	56	257.7	446.7	58	50
Detroit, Mich.	T.	43	43	63	79	86	91	94	97	98	98	88	84	81	74	59	44	279.4	451.9	62	34
Dodge City, Kans.	P.	31	47	47	55	59	65	65	68	66	67	67	68	64	57	44	30	358.7	451.9	79	63
Eastport, Me.	P.	40	48	53	62	70	80	85	86	86	87	81	81	66	54	57	61	278.2	441.7	63	58
Eureka, Cal.	P.	21	24	35	51	56	59	65	65	74	72	63	59	58	46	30	31	278.3	400.7	60	43
Galveston, Tex.	P.	19	19	63	79	82	84	86	86	87	83	83	81	78	65	51	.....	313.5	441.8	74	67
Helena, Mont.	P.	39	35	47	50	61	60	64	55	59	55	62	55	38	35	25	31	329.0	467.4	49	44
Kansas City, Mo.	P.	43	41	52	60	54	58	52	52	56	63	60	64	55	35	28	28	229.7	443.8	52	40
Little Rock, Ark.	T.	41	57	57	67	77	68	97	95	89	88	85	91	80	70	47	50	342.7	434.2	79	61
Louisville, Ky.	T.	45	59	60	60	75	85	82	80	83	88	87	84	73	68	56	43	325.6	441.7	74	52
New Orleans, La.	T.	.....	72	63	76	83	81	80	81	82	70	71	65	57	32	13	.....	384.0	433.7	67	64
New York, N. Y.	T.	18	24	36	50	58	61	69	70	70	60	56	52	41	29	22	34	219.6	449.1	49	46
Northfield, Vt.	P.	22	37	48	63	58	55	57	58	57	64	60	60	64	49	31	19	247.7	457.9	52	42
Philadelphia, Pa.	T.	36	37	57	52	61	72	82	78	82	81	84	79	67	57	43	35	287.7	446.7	64	36
Phoenix, Ariz.	P.	73	81	87	92	88	92	93	85	86	92	91	90	91	90	83	100	381.6	450.7	89	80
Portland, Me.	T.	0	5	39	63	76	75	73	74	74	77	76	71	54	42	17	2	179.9	322.9	56	43
Portland, Oreg.	T.	30	23	24	37	34	38	37	48	48	37	38	38	35	24	20	37	158.7	464.1	34	43
Do	P.	30	24	28	34	35	35	34	36	39	31	37	42	39	36	31	37	158.9	464.1	34	43
Rochester, N. Y.	T.	45	57	67	77	86	92	97	99	99	100	98	99	99	91	74	61	303.8	454.9	87	69
St. Louis, Mo.	T.	22	40	57	65	80	84	87	89	89	89	86	84	83	70	45	11	326.4	443.8	74	55
Salt Lake City, Utah	P.	41	39	42	51	52	55	59	57	62	59	59	60	54	49	49	59	297.8	449.1	53	36
San Diego, Cal.	P.	87	66	58	56	70	78	84	90	86	82	88	82	73	59	50	40	318.5	430.7	74	65
San Francisco, Cal.	T.	.....	44	59	71	80	84	88	98	87	77	77	64	53	44	.....	21	276.2	441.7	63	62
Santa Fe, N. Mex.	P.	78	74	90	90	89	84	81	84	83	83	78	77	66	28	10	21	351.5	436.7	81	64
Savannah, Ga.	P.	75	69	75	82	83	84	81	70	71	77	79	77	64	53	44	.....	310.8	438.4	73	59
Vicksburg, Miss.	T.	38	42	52	68	82	89	94	93	92	91	85	81	83	70	54	.....	330.4	428.4	77	72
Washington, D. C.	P.	38	36	42	47	49	57	55	53	44	47	47	44	45	40	29	25	200.0	443.8	45	40
Wilmington, N. C.	T.	14	35	46	74	86	86	86	93	90	91	87	84	74	43	18	0	307.5	432.6	71	55

* All values for 25 days. † All values for 22 days.

TABLE XII.—Maximum rainfall in one hour or less, May, 1896.

Stations.	Maximum rainfall in—					
	5 min.	Date.	10 min.	Date.	1 hour.	Date.
	Inch.		Inch.		Inch.	
Atlanta, Ga.	0.40	26	0.45	20	0.70	26
Bismarck, N. Dak.	0.06	22	0.08	22	0.33	22
Boston, Mass.	0.30	19	0.28	19	0.46	19
Buffalo, N. Y.	0.31	26	0.43	26	0.43	26
Chicago, Ill.	0.50	25	1.00	25	1.34	25
Cincinnati, Ohio	0.23	25	0.36	25	0.49	25
Cleveland, Ohio	0.07	21	0.11	21	0.31	15
Denver, Colo.	.....	.....	0.01	15	0.07	15
Detroit, Mich.	0.12	27	0.13	27	0.18	27
Dodge City, Kans.	0.20	8	0.38	8	0.50	8
Duluth, Minn.	0.21	13	0.28	13	0.63	13
Eastport, Me.	0.06	29	0.12	29	0.20	29
Galveston, Tex.	0.07	3	0.15	3	0.45	3
Indianapolis, Ind.	0.40	25	0.60	25	1.09	25
Jacksonville, Fla.	0.10	25	0.18	25	0.50	25
Jupiter, Fla.	0.23	23	0.35	23	0.58	31
Kansas City, Mo.	0.80	31	1.05	31	1.15	31
Key West, Fla.	0.16	30	0.17	30	0.24	30
Little Rock, Ark.	0.08	20	0.06	20	0.26	13
Louisville, Ky.	0.23	28	0.35	28	0.82	28
Memphis, Tenn.	0.16	20	0.28	20	0.89	20

TABLE XII.—Maximum rainfall—Continued.

Stations.	Maximum rainfall in—					
	5 min.	Date.	10 min.	Date.	1 hour.	Date.
	Inch.		Inch.		Inch.	
Milwaukee, Wis.	0.07	27	0.10	27	0.25	1
Nantucket, Mass.	0.17	28	0.23	28	0.45	28
Nashville, Tenn.	0.25	31	0.40	31	1.23	31
New Orleans, La.	0.35	25	0.63	25	0.82	25
New York, N. Y.	0.15	28	0.25	28	0.46	28
Norfolk, Va.	0.39	31	0.50	31	0.97	31
Omaha, Nebr.	0.37	12	0.43	12	0.90	11
Philadelphia, Pa.	0.24	3	0.42	3	0.92	3
Portland, Me.	1.08	21	0.13	21	0.58	31
Portland, Oreg.	0.09	23	0.19	23	0.25	23
Rochester, N. Y.	0.26	26	0.25	26	0.41	26
St. Louis, Mo.	0.55	27	0.66	27	1.33	27
St. Paul, Minn.	0.48	12	0.57	12	0.87	12
Salt Lake City, Utah	0.15	20	0.17	20	0.30	20
San Diego, Cal.*	0.03	11	0.05	11	0.14	11
Savannah, Ga.	0.45	5	0.73	5	0.92	5
Seattle, Wash.	0.07	22	0.14	22	0.45	22
Vicksburg, Miss.	0.28	20	0.37	20	0.74	20
Washington, D. C.	0.36	19	0.45	19	0.55	19
Wilmington, N. C.	0.15	3	0.23	3	0.55	3

* Less than 0.03 inch in one hour.

TABLE XIII.—Excessive precipitation, by stations, for May, 1896.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Alabama.						
Carrollton	Inches.	Inches.		Inch.	A.m.	
Clanton				1.78	1 00	1
Cordova		2.93	1-2	1.73	1 30	14
Demopolis		2.99	28-29			
Eufaula				1.42	1 30	23
Florence				1.30	1 30	26
Healing Springs		2.83	1			
Tuscaloosa				1.75	1 30	14
Arkansas.						
Dallas		2.60	12-13			
Fayetteville		2.75	20			
Fort Smith		2.85	22			
Helena				1.00	1 00	2
Mossville		2.50	30			
Silver Springs		2.56	30	2.56	2 00	30
Wiggs				1.96	1 50	28
California.						
Bear Valley	10.03					
Fordyce Dam		3.00	1			
Redding		2.65	3			
Do		2.52	22			
Shasta		2.83	22			
Colorado.						
Longmont		4.62	30	4.62	1 30	30
Vilas				1.74	1 00	7
Florida.						
Brooksville				2.15	1 30	28
Emerson		3.29	21			
Fort Meade		2.60	6			
Lake Butler				2.00	1 30	6
Myers		3.00	6	1.07	1 00	27
Orange Park				2.30	0 45	2
Oxford				1.60	0 50	1
Quincy		2.75	21			
Georgia.						
Augusta				1.37	1 00	5
Dahlonega		2.60	23			
Fleming		3.00	29	3.00	0 45	29
Fort Gaines				2.04	0 30	2
Gillsville		2.85	22	2.85	0 35	22
Thomasville				2.01	1 50	1
Illinois.						
Albion	13.21	4.80	1	4.80	4 00	1
Ashton		3.40	24-25			
Atwood		2.70	21	2.70	1 00	21
Aurora				1.95	0 55	1
Calro	10.82	3.16	16-17	3.03	2 32	16
Do		2.84	26-27			
Carlinville		4.04	18-19			
Charleston		2.98	11			
Chicago				1.34	1 00	25
Cisne				2.36	2 00	27
Cobden		2.99	19-20			
Duquoin		2.65	28			
Greenville		3.70	18-19			
Iron		3.02	1	3.02	2 30	1
Jordans Grove		3.50	27			
Kishwaukee		6.00	24-25	6.00	2 30	24-25
Lanark		3.73	24-25			
Mascoutah		4.50	27			
Morrisonville		2.51	19-20			
Mount Vernon		2.85	27	2.85	2 45	27
Oswego		2.70	24			
Plumhill		2.50	27			
Riley		2.80	25	2.80	0 55	25
St. John		3.00	27			
Scales Mound		3.47	24	3.47	2 00	24
Winnebago		2.70	24-25			
Indiana.						
Huntington		3.52	25			
Indianapolis				1.09	0 25	25
Princeton		3.95	27			
Sunman				1.30	1 00	25
Indian Territory.						
Vinita		5.52	15-16			
Iowa.						
Amana				1.70	0 30	23
Bonaparte		2.66	16			
Carroll		3.04	14-15			
Centerville				1.10	0 30	27
College Springs				1.30	0 50	26
Council Bluffs	11.15	2.63	13			
Cresco				1.90	1 00	24
Davenport				1.10	1 00	16
Delaware		3.62	24			
Dubuque		2.80	24	1.95	0 45	24
Eldora				1.40	0 10	23
Fairfield		3.18	16			
Glenwood	10.03	2.70	13			
Grand Meadow		3.20	24	3.00	3 00	24
Grinnell		3.21	23			
Grundy Center				1.10	0 35	23
Humboldt		3.40	14			
Iowa Falls				1.75	0 15	23
Mountair	11.79					
Neola		2.80	16			
Ogden		3.45	16	1.04	0 40	24
Reinbeck				1.67	0 30	23
Winterset		3.00	16			

TABLE XIII.—Excessive precipitation—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Kansas.						
Blaine		Inches.	Inches.	Inch.	A.m.	
Campbell			2.50	30-31		
Collyer			3.16	31		
Columbus	11.41		3.33	15	2.00	1 30 30
Do.			2.60	19		
Eureka					1.27	1 00 18
Fort Riley					1.40	0 50 19
Fort Scott	12.67		3.40	29-30		
Frankfort	10.38		4.85	31		
Gove					1.58	1 00 29
Grainfield					1.40	1 00 31
Horton	10.51		2.68			
Independence			2.81	16	1.65	0 50 23
Marion			2.70	22		
Minneapolis					1.10	0 30 19
Do.			2.52	30-31	1.76	0 30 31
Paola			2.65	15		
Do.			2.60	19	2.00	0 25 19
Wakefield	12.01				1.26	0 50 12
Do.					1.81	0 26 19
Do.			4.34	30-31	1.84	1 07 30
Wamego					1.00	1 00 30
Do.					1.46	1 00 31
Yates Center					1.50	0 40 23
Kentucky.						
Alpha					1.85	1 30 22
Caddo			3.10	25-27		
Earlington	11.47					
Fords Ferry	11.78		3.66	31		
Princeton	11.10					
Louisiana.						
Lafayette					1.53	1 30 13
Melville			4.50	3	4.50	2 00 3
Oberlin					1.25	1 00 14
Schriever					1.54	0 30 24
West End			2.70	3-4		
Michigan.						
Bay City			3.00	25	1.80	0 25 25
Calumet			3.58	17		
Charlevoix					2.00	2 00 27
Cheboygan			2.91	27-28		
Mayville					1.00	0 30 25
Midland					2.35	2 00 25
Old Mission			2.70	27		
Sault Ste Marie			2.51	27-28		
Thornville					1.00	1 00 25
Minnesota.						
Breece			3.46	17-18		
Faribault			2.65	12		
Lambert	10.60		3.00	17		
Mississippi.						
Leakesville			3.50	2		
Thornton			2.50	1-2		
Williamsburg			4.06	2-3	1.98	1 00 13
Missouri.						
Appleton City	13.12		3.40	30		
Arlington	11.28		3.04	15-16		
Do.			3.31	21-22		
Arthur	14.86		2.60	19		
Do.			3.10	29		
Bagnell			2.75	21-22		
Boonville			3.56	15-16		
Brunswick	11.52		3.81	19		
Cedargap			3.40	19-20	1.00	1 30 19
Columbia			2.50	15-16		
Conception	13.30		3.48	30	1.80	1 00 20
Cowgill			3.08	18-19		
Edgehill	10.22					
Eightmile			3.00	29-30		
Eldon			3.63	19		
Fairport	12.42		4.35	31	2.15	9 00 17
Gallatin	10.25					
Gayoso			2.95	19-20		
Grovedale	11.53		2.60	30		
Halfway	12.58		4.66	15-16		
Do.			2.66	19-20		
Hannibal			2.79	27		
Harrisonville			2.72	15		
Hastain	10.97		3.30	22-23		
Irena	11.33					
Jefferson City			2.80	19		
Do.			2.50	21	1.15	1 00 31
Kansas City					1.25	0 25 18
Kidder			2.66	18		
Lamar	16.10		2.89	19		
Do.			3.68	30		
Lamonte			3.88	15-16		
Lebanon	13.65		5.60	15		
Do.			2.70	19		
McCune			3.82	27		
Mansfield			2.57	20-21		
Marble Hill	10.23		4.26	26-27		
Maryville	12.38		3.33	31		
Mineralspring	11.78		4.50	30		
Montreal			2.54	15-16	1.84	1 00 21
Neosho	11.91		4.40	29-30		
Nevada	16.70		3.45	15-16		
Do.			2.70	23		
Do.			3.62	29-30		
New Madrid			4.01	19-20	1.00	1 00 25-26

TABLE XIII.—Excessive precipitation—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Missouri—Continued.		Inches.	Inches.	Ins.	A. m.	
Oakfield		3.38	18-19			
Do		2.72	27			
Oregon	15.02	2.75	17			
Do		3.38	31			
Oseola	18.23	3.43	19	1.00	1 00	18
Do		3.41	21-22	1.83	1 00	21
Do				1.58	1 00	22
Palmyra		2.70	27			
Phillipsburg	12.67	4.25	15-16			
Do		3.53	19			
Pickering	10.80	2.63	31			
Platte River		2.65	15			
Princeton	10.02					
Rhineland		3.40	18-19			
Richmond				1.00	0 30	19
Rolla	10.04	2.55	15-16			
St. Charles		3.56	27			
St. Louis		3.08	27	1.33	1 00	27
Sarcosie	10.14					
Shelbina	10.00	3.20	27			
Springfield	11.46	2.55	15-16			
Do		2.54	19-20			
Stellada		2.56	15-16			
Sublett	13.15	3.00	18			
Do		3.00	26-27	2.25	2 00	27
Tindall		2.52	31			
Trenton	10.34					
Unionville	12.60	4.96	17-18	3.04	2 18	17
Virgil City	12.45	3.03	15-16			
Wheatland	14.70	3.68	19-20			
Do		3.11	21-22			
Nebraska.						
Arapaho		2.50	31			
Ashland	10.37	2.90	13			
Auburn				1.00	0 55	20
Beatrice	10.30	3.08	30-31			
Beatrice	11.86	4.18	17			
Bratton		3.00	4			
Burchard	11.05	3.00	17			
Gibson		3.00	17			
Kearney		2.90	31			
Lincoln	10.11	2.78	12			
McCook		2.60	30			
Minden		2.70	30-31			
Nemaha	11.01			1.10	0 35	20
Odell	12.33	4.05	3			
Plattsmouth	10.55					
Rulo	13.77	4.30	17	4.20	3 30	17
Santee Agency				1.11	0 30	24
Spencer				1.55	1 30	24
State Farm		3.05	12-13			
Strang		2.60	15-16			
Superior		3.77	31			
Sutton		3.25	30-31			
Tekamah		2.60	16			
Turlington				1.01	0 50	20
Weeping Water	11.45					
New Jersey.						
Bridgeton				1.30	0 15	28
Hightstown				2.03	1 00	28
New Brunswick				2.00	0 20	28
North Carolina.						
Falkland	11.22	4.90	23			
Fayetteville		2.71	1			
Greenville		3.25	17			
Horse Cove		3.43	2	2.00	1 00	2
Jefferson				1.15	1 00	13
Louisburg				1.30	0 20	23
Lynn		2.74	2			
Monroe		3.30	24			
Saxon				1.00	1 00	22
Shyuka		3.32	2			
Williston	10.61					

TABLE XIII.—Excessive precipitation—Continued.

Stations.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
<i>North Dakota.</i>						
McKinney		2.50	11-12			
Milton		2.65	17			
New England City		3.00	11-12			
Oakdale		2.76	12			
University		3.13	16-17			
<i>Oklahoma.</i>						
Burnett	10.21	6.02	18	6.02	4 50	18
Guthrie		3.10	21			
Norman		2.50	19			
Ponca City				1.30	0 30	22
Stillwater		2.78	21			
<i>Oregon.</i>						
Detroit	10.48					
Gardiner	10.24					
Glenora	11.34					
Langlois	10.26					
Salmon	15.36					
<i>Pennsylvania.</i>						
Bethlehem		3.45	28	3.08	2 00	28
Easton		2.87	28-29			
Pittsburg				1.00	1 00	13
Shinglehouse		2.70	26			
<i>South Carolina.</i>						
Camden				1.27	1 00	2
Clemson College		3.02	2-3			
Conway				2.00	1 50	29
Greenville		2.72	2-3			
Longshore				1.70	1 00	36
Pinopolis		2.94	21-22			
<i>South Dakota.</i>						
Greenwood				1.70	1 00	24
Huron				1.24	0 47	23
<i>Tennessee.</i>						
Charlotte		3.33	19-20			
Dyersburg		2.90	30			
Elk Valley				1.00	1 00	31
Harriman				1.00	0 10	31
Knoxville				1.00	0 35	30
Nashville				1.23	1 00	31
Pope				1.25	1 00	31
Trenton		2.95	19-20			
Union City		2.90	19-20			
<i>Texas.</i>						
Aurora		3.05	15-16	3.00	1 30	15
Brighton				2.00	1 00	3
Burnet				1.01	1 00	12
College Springs				1.97	1 18	13
Corpus Christi				1.25	1 00	2-3
Corsicana		2.72	12-13			
Dallas		2.90	12-13			
Estelle		3.03	12			
San Antonio		2.75	2	2.75	2 30	2
San Antonio (W. B.)				2.00	1 00	2
<i>Virginia.</i>						
Cape Henry	10.61	3.00	21-22			
Fredericksburg				1.34	0 30	22
Lynchburg				1.30	1 00	26
Manassas		2.53	23			
Petersburg		2.52	3			
<i>West Virginia.</i>						
Leachtown		3.20	23			
<i>Wisconsin.</i>						
Apollonia				1.43	1 00	13
Beloit		2.50	24 25			
Grand River Lock		3.60	13			
Pine River		3.00	12			
Portage		3.10	13			
Prairie du Chien		3.08	24			

Chart I. Tracks of Centers of Low Areas. May, 1896.

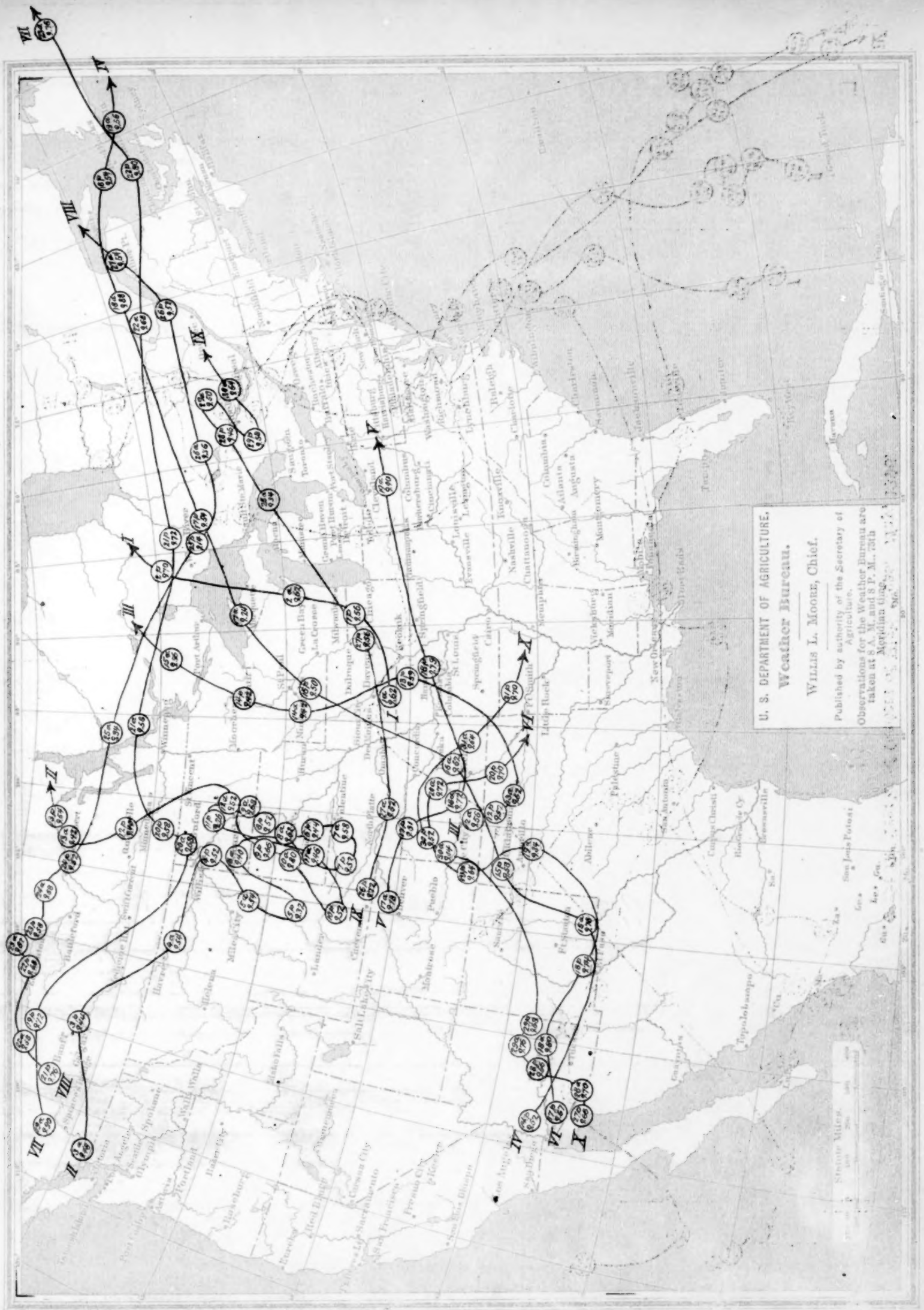


Chart II. Tracks of Centers of High Areas. May, 1898.

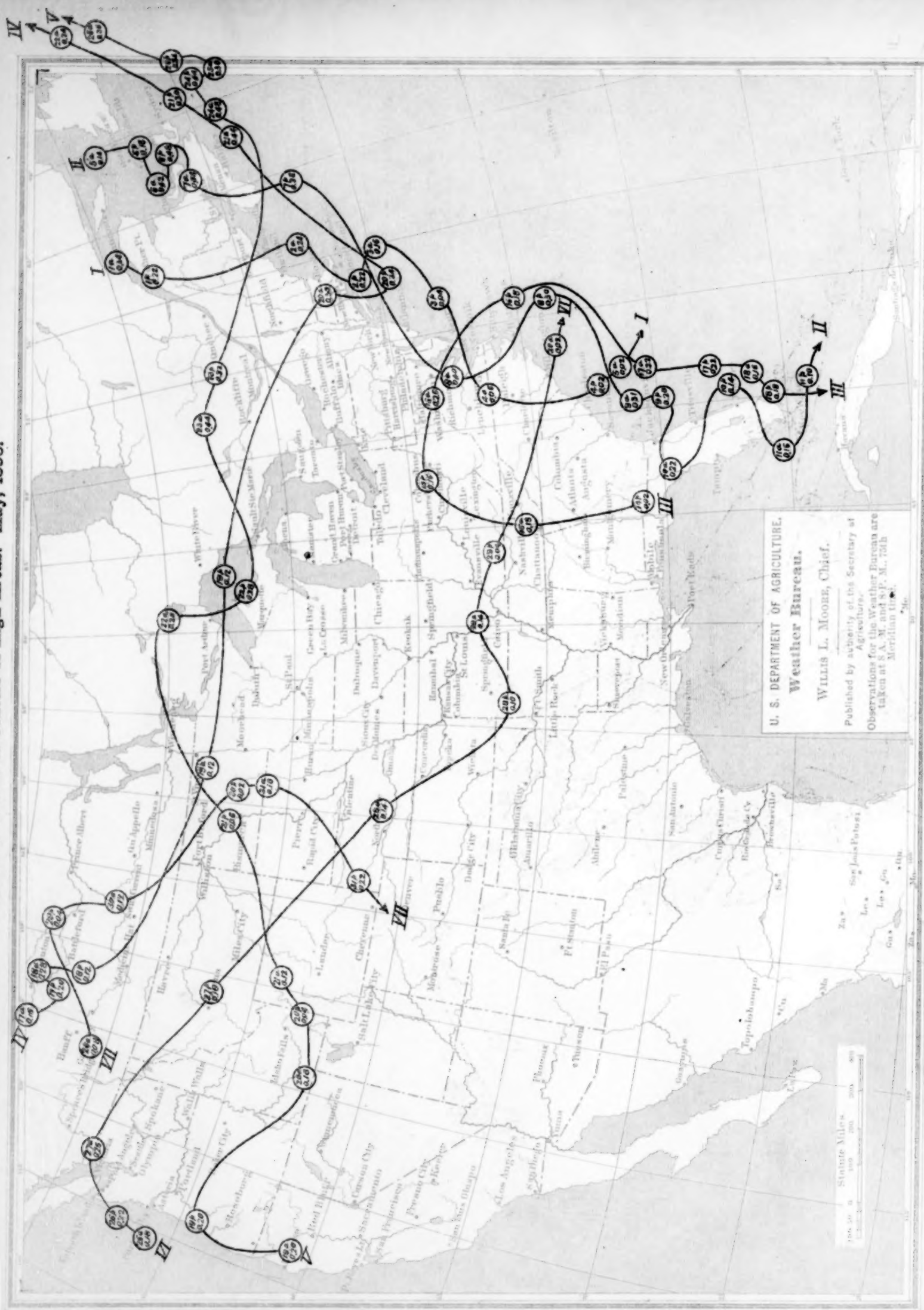


Chart III. Total Precipitation. May, 1896.

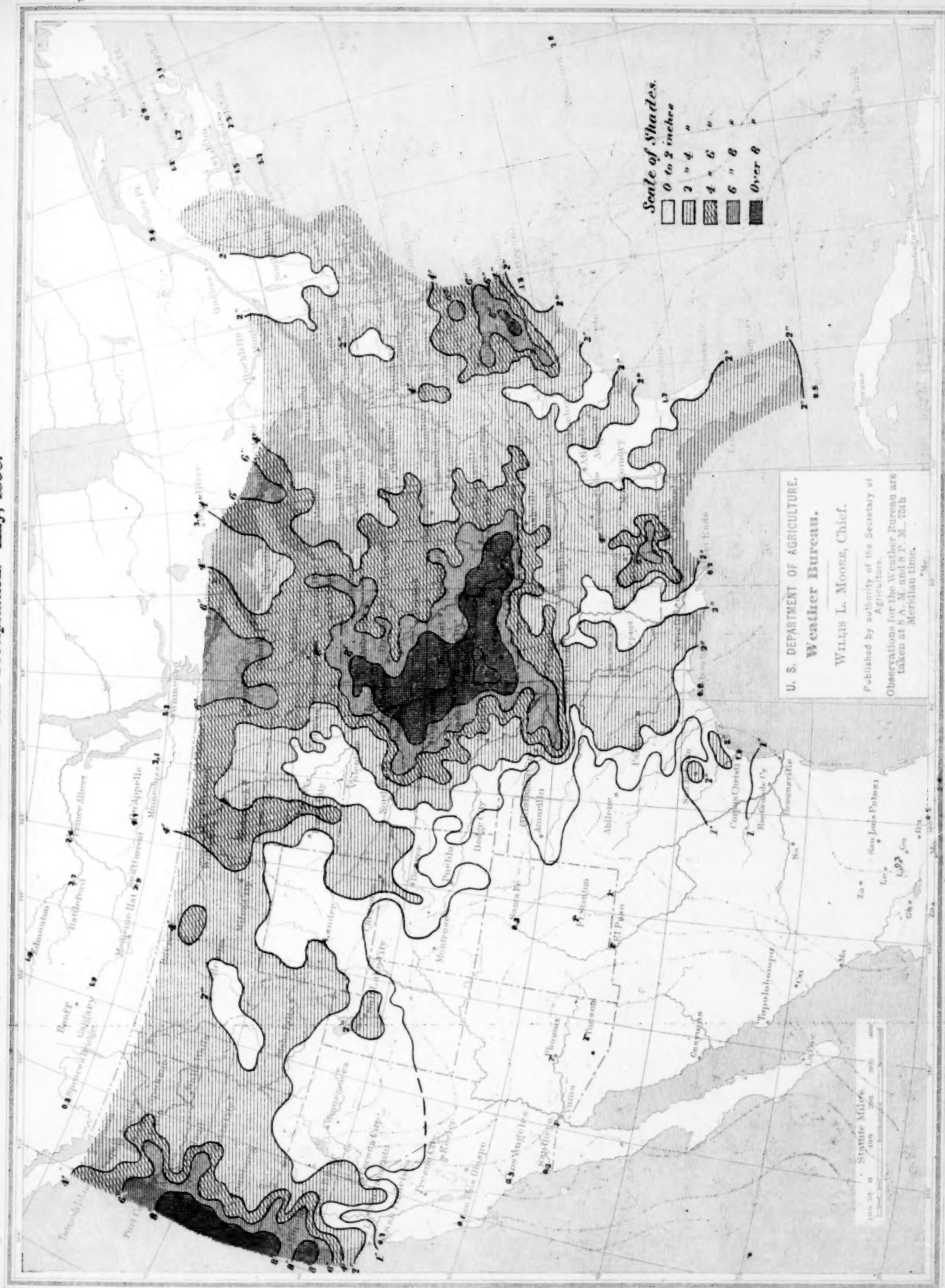


Chart IV. Isobars, Isotherms, and Resultant Winds. May, 1896.

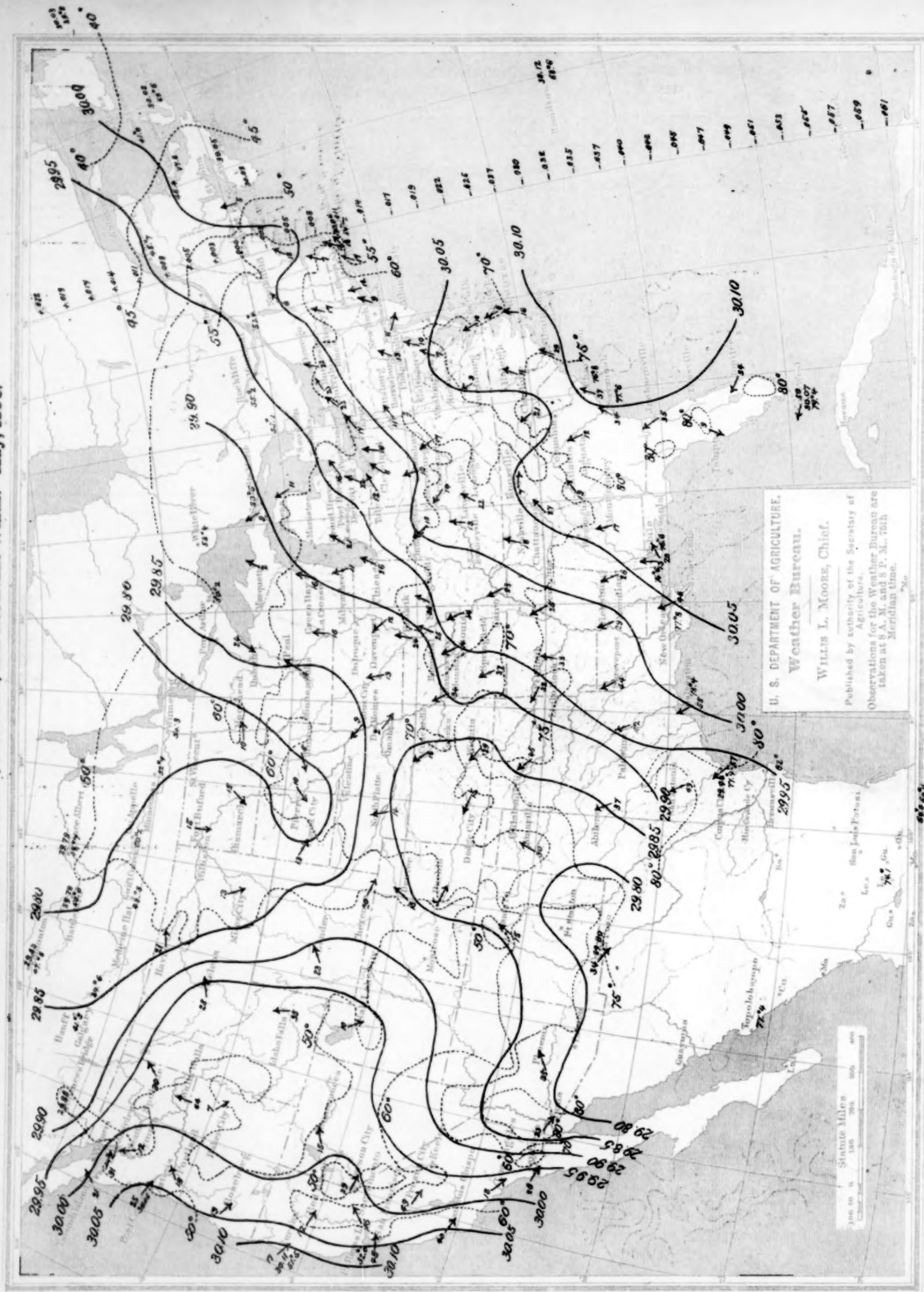


Chart V. Relative Variations of the Horizontal Magnetic Force, the Magnet-Watch Integrator, and the Northwest Pressures and Temperatures. May, 1896.

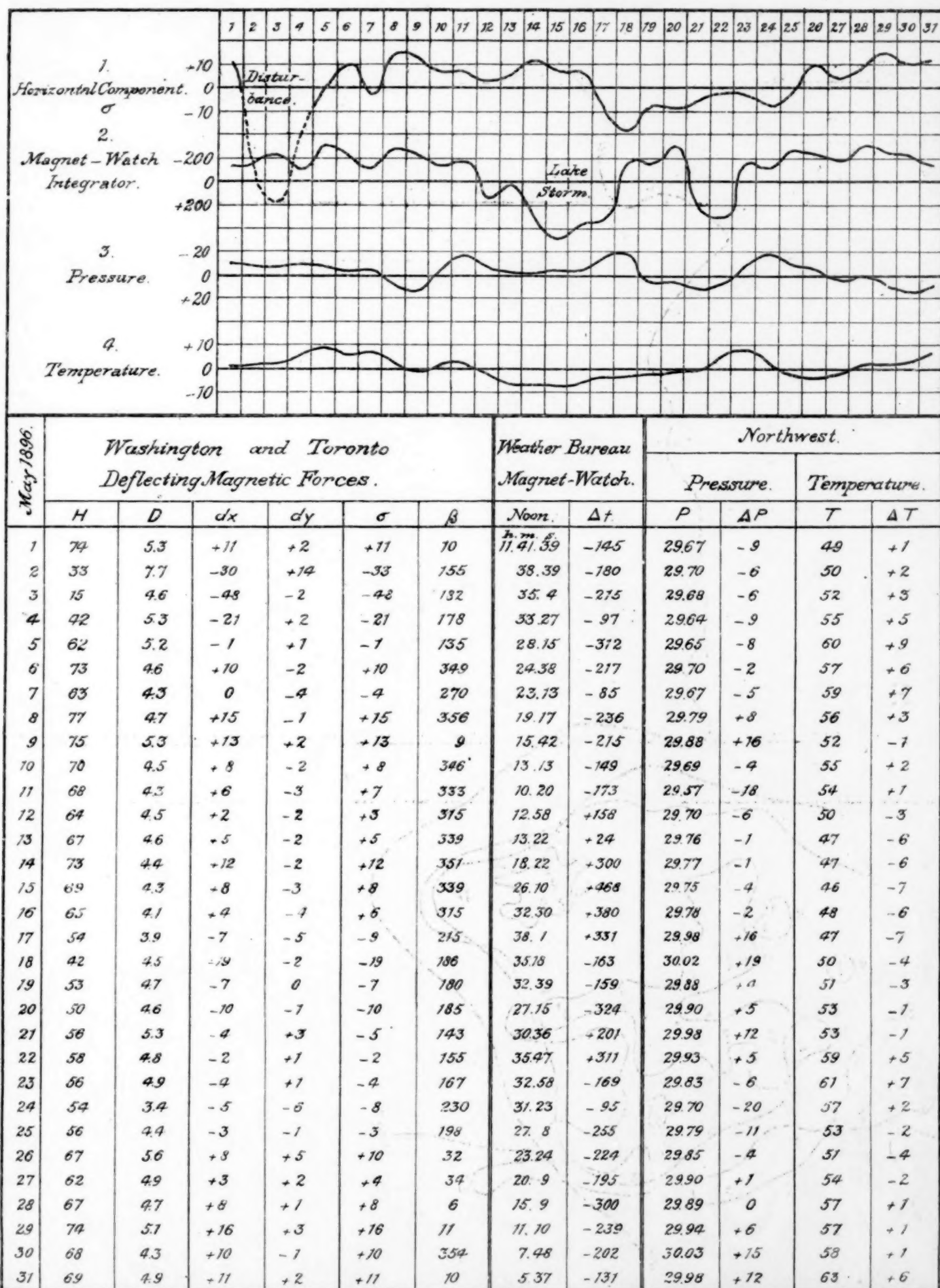
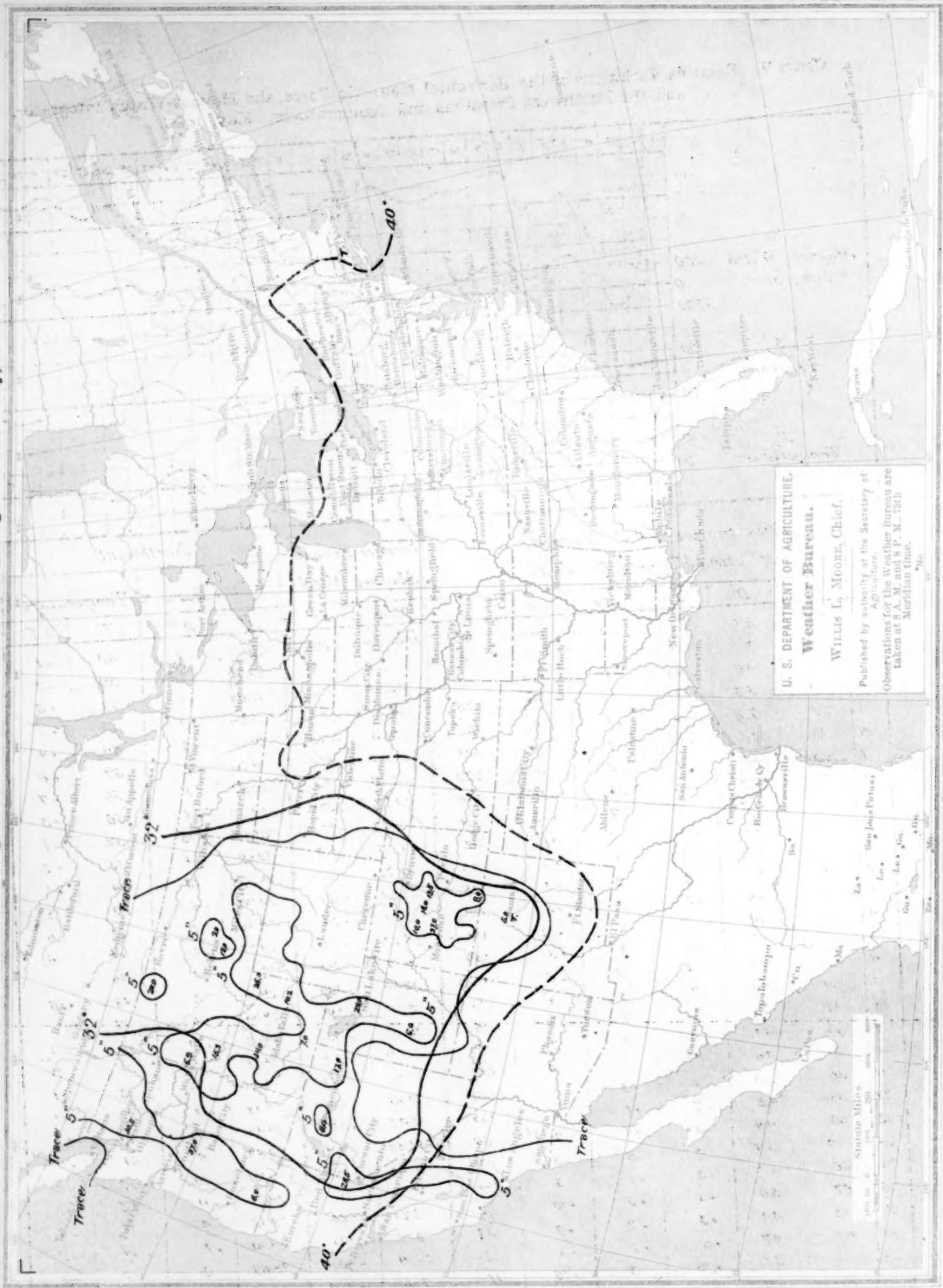


Chart VI. Depth of Snowfall and Limits of Freezing Weather. May, 1896.



U. S. DEPARTMENT OF AGRICULTURE.

Weather Bureau.

Willis L. Moore, Chief.

Published by authority of the Secretary of Agriculture.
Observations for the Weather Bureau are taken at 8 A. M. and 8 P. M. 75th Meridian time.

Chart VII. Total Annual Snowfall July 1, 1895, to June 30, 1896.

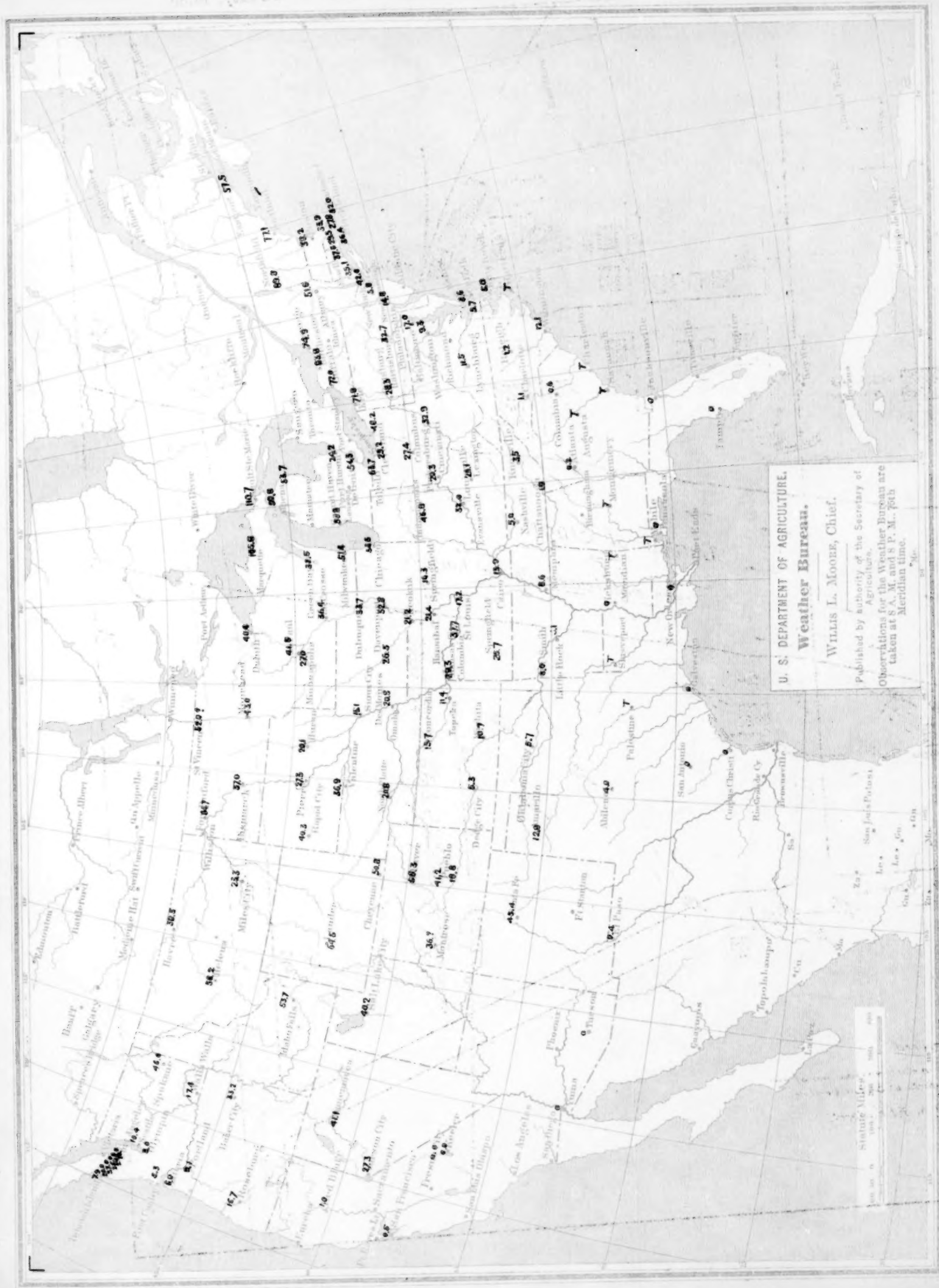


Chart VIII. Path of Tornado of May 25, 1896, at Thomas, Oakland County, Mich.

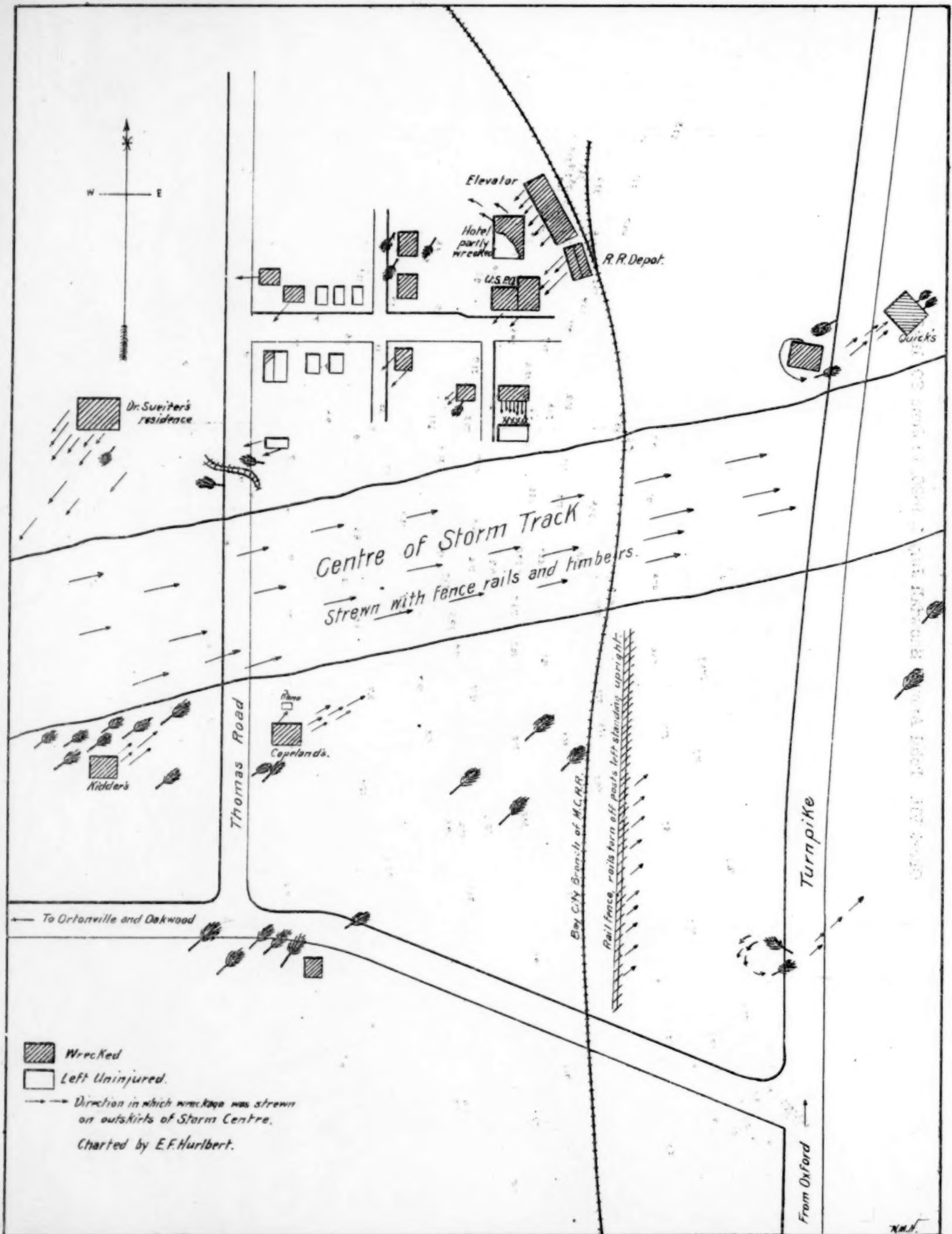


Chart IX. Kite Experiments at the Weather Bureau.

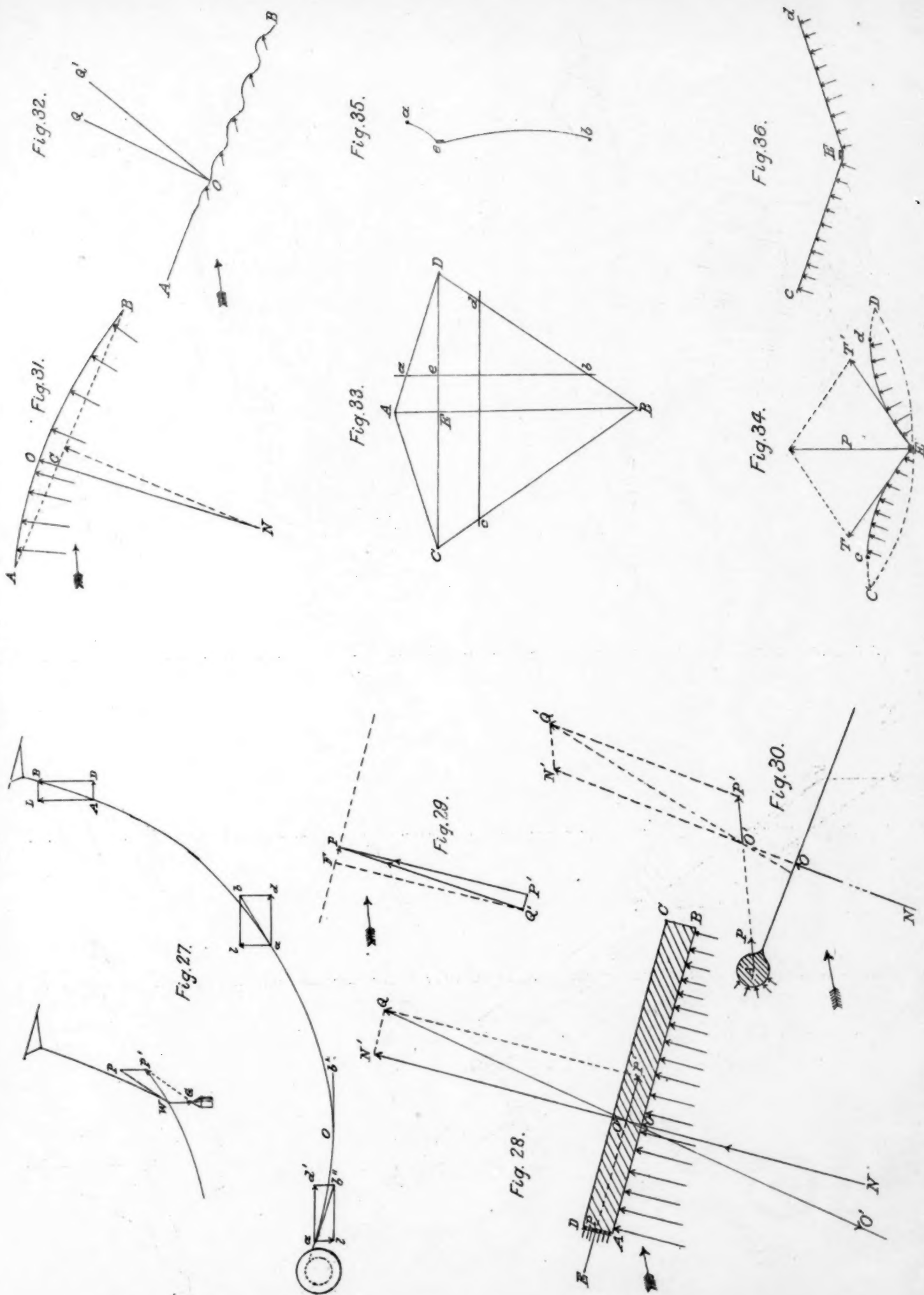


Chart X. Kite Experiments at the Weather Bureau.

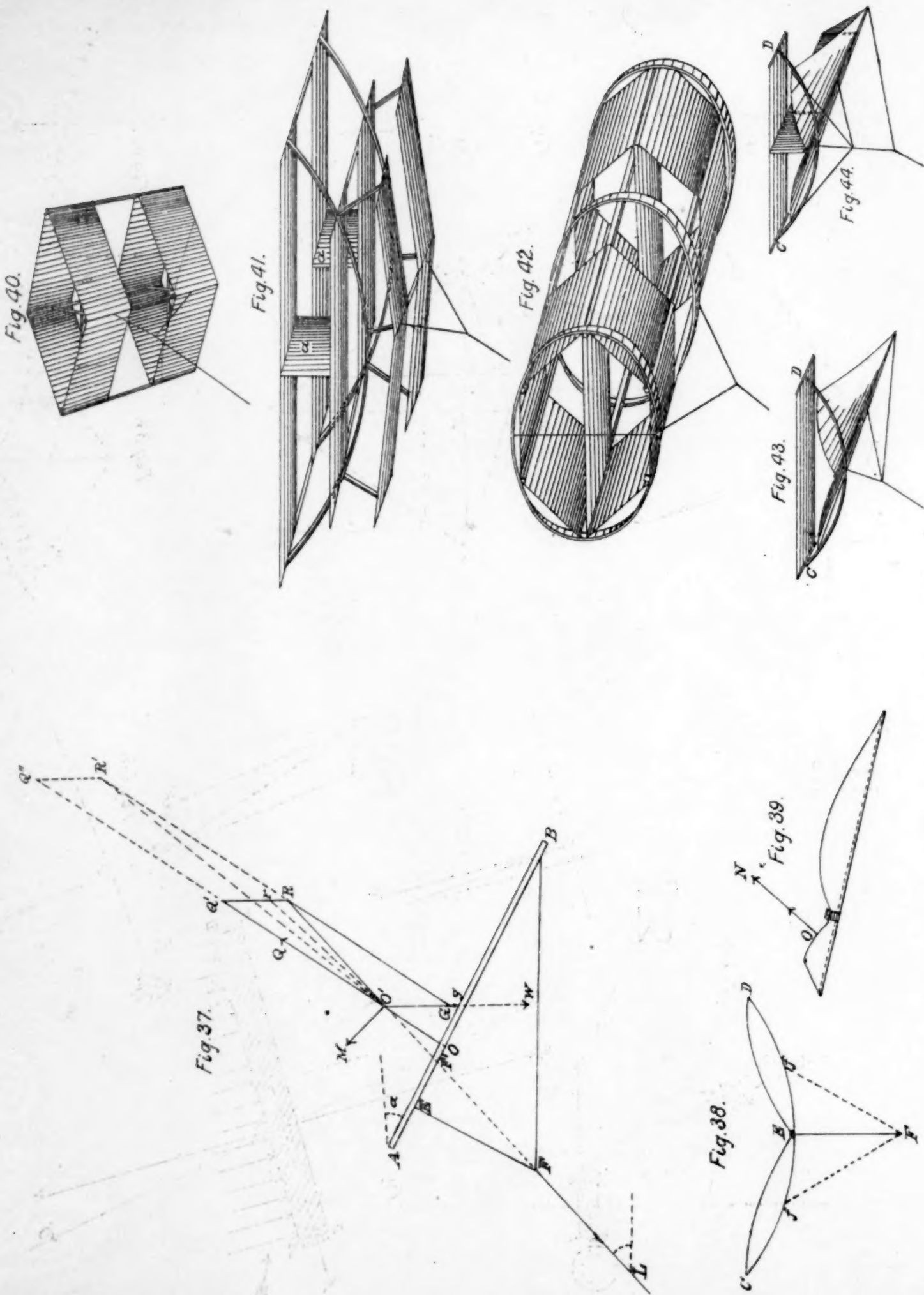


Chart XI. Kite Experiments at the Weather Bureau.

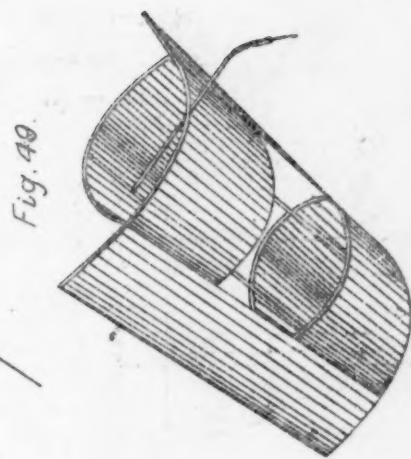
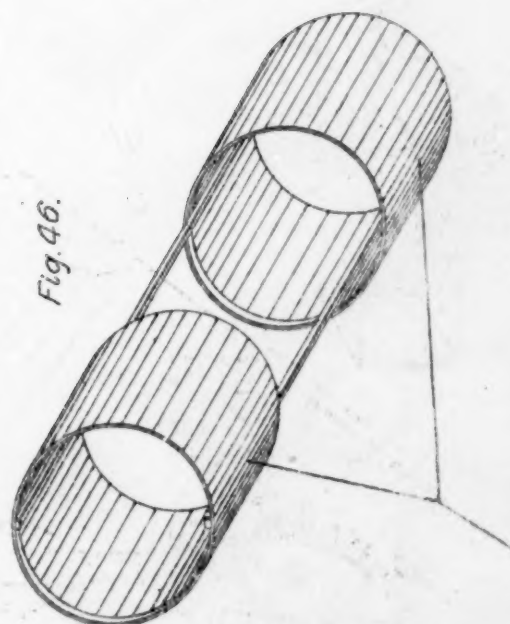
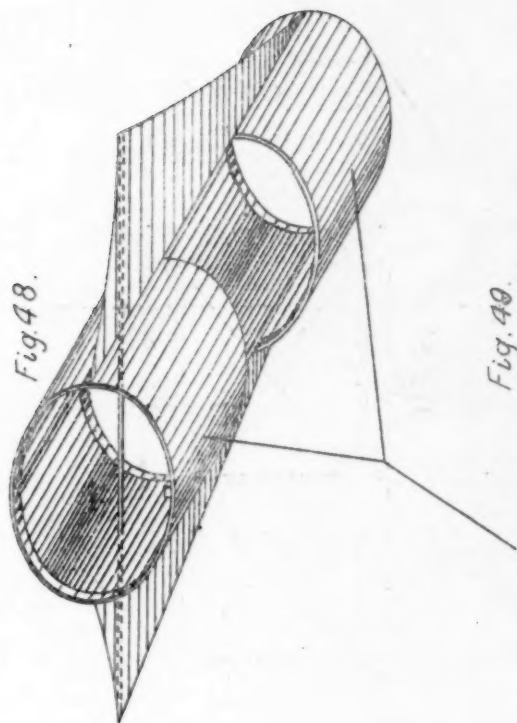
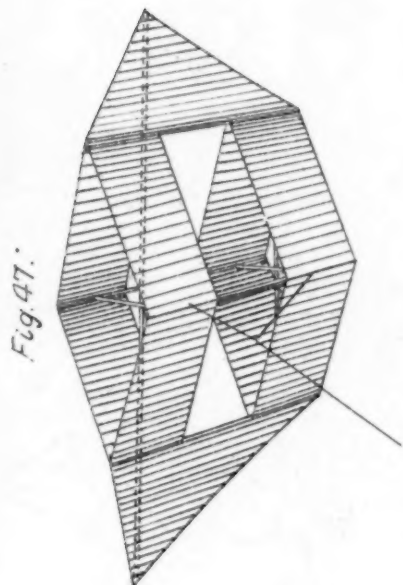
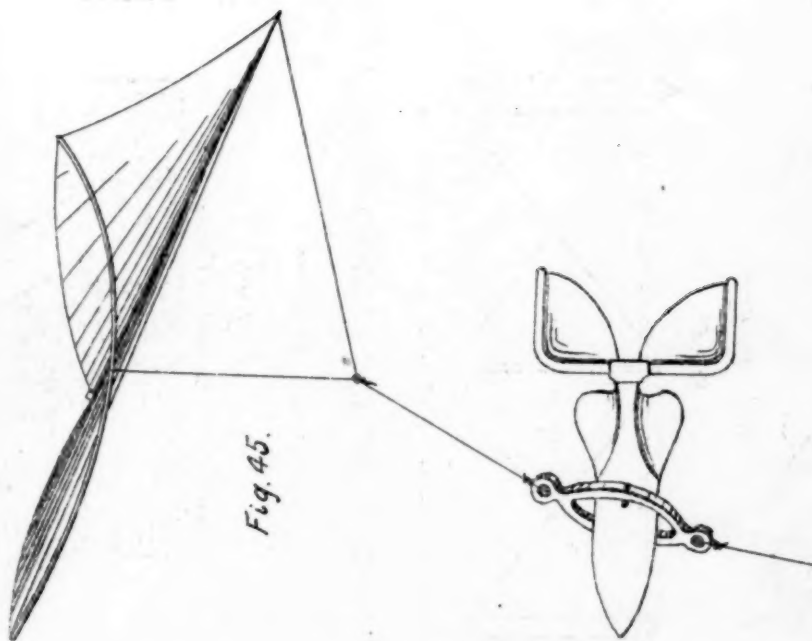


Chart. XII. Kite Experiments at the Weather Bureau.

Fig. 51.

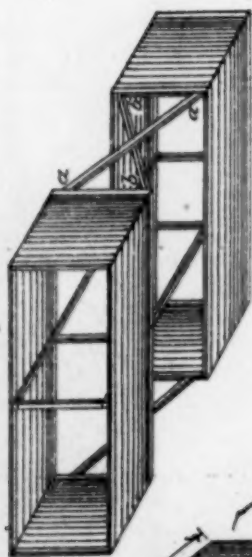
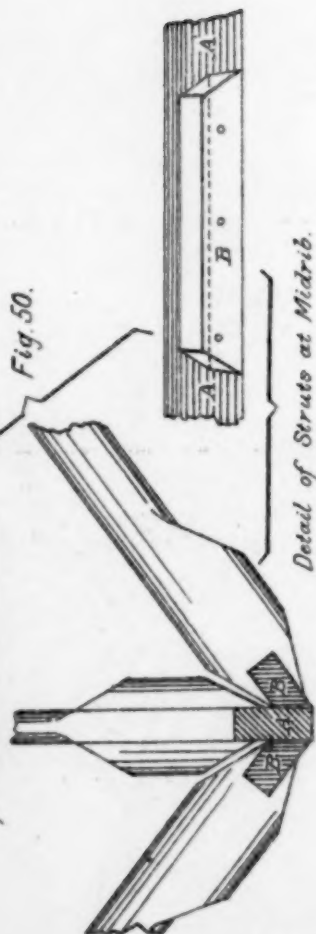
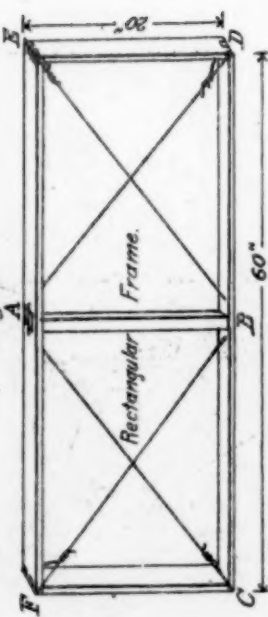


Fig. 50.



Detail of Struts at Midrib.

Fig. 52.

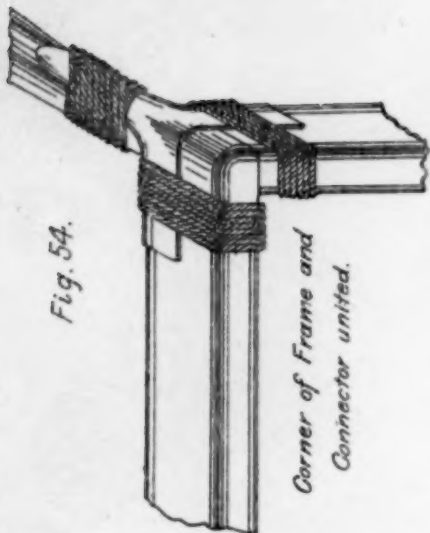


Frame Connector.

Fig. 53.



Fig. 54.



Corner of Frame and Connector united.

Fig. 55.

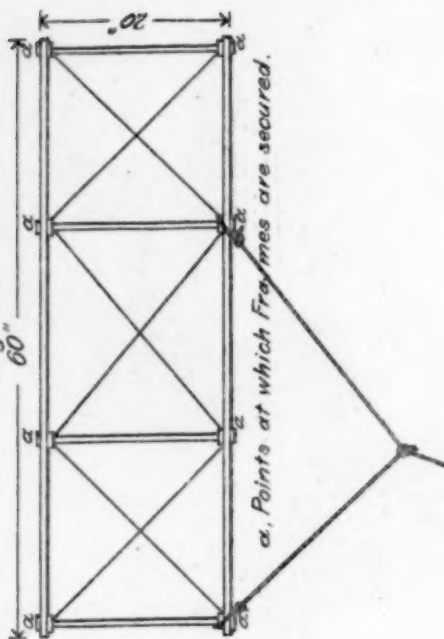


Fig. 56.

